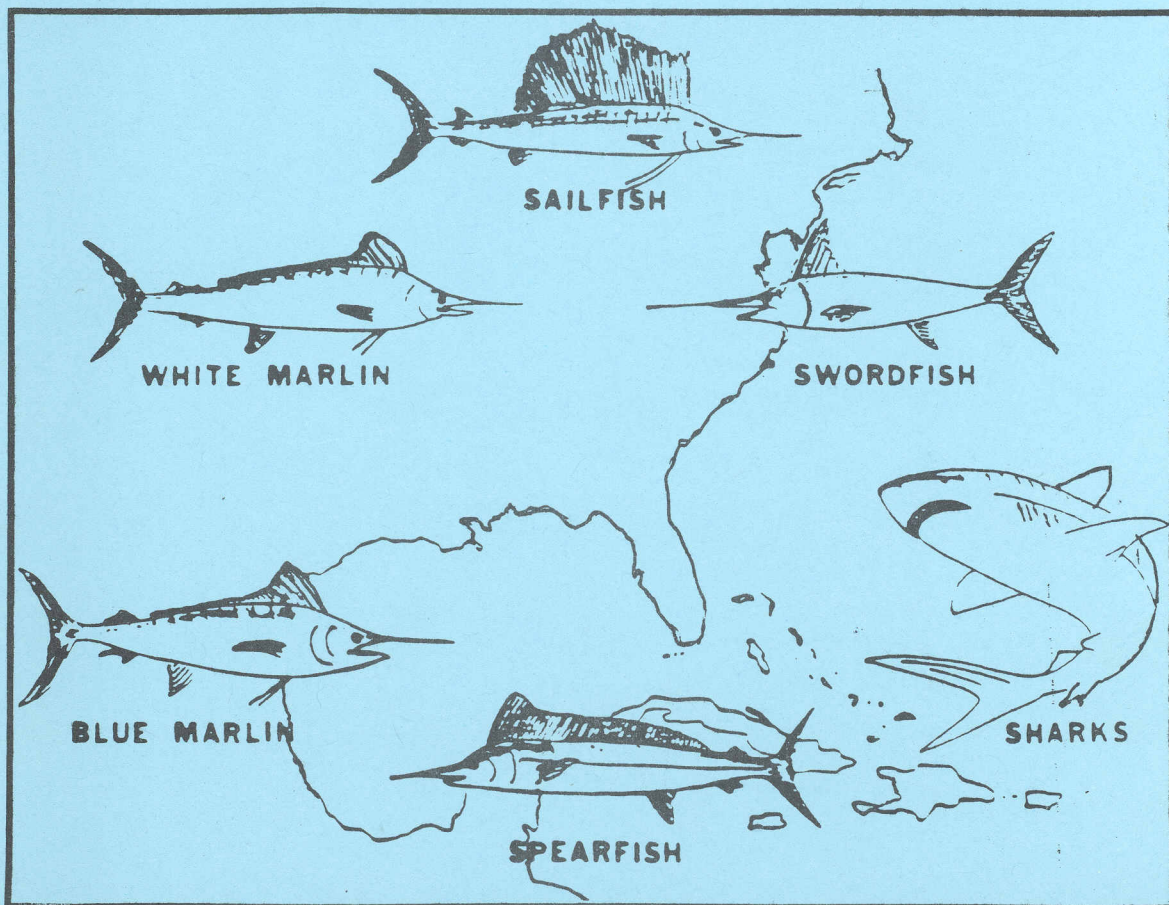# NOAA Technical Memorandum NMFS-SEFC-5

Survey of the Recreational Billfish and Shark Fisheries

MAY 1, 1977 to APRIL 30, 1978

ANALYST:
David C. Hamm
Physical Scientist

SURVEY DESIGN:
Beany M. Slater
Survey Statistician

March 1979

NOAA Technical Memorandum NMFS-SEFC-5

SURVEY OF THE RECREATIONAL BILLFISH AND SHARK FISHERIES
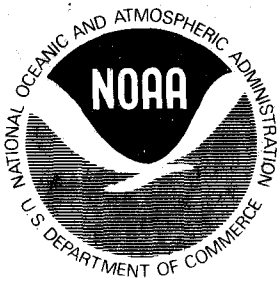
MAY 1, 1977 to APRIL 30, 1978

David C. Hamm
Physical Scientist
(Analyst)

Beany M. Slater
Survey Statistician
(Survey Design)

March 1979

EXECUTIVE SUMMARY

The Technical and Information Management Services (TIMS) of the Southeast
Fisheries Center (SEFC), National Marine Fisheries Service (NMFS) designed
and conducted a survey to estimate the number of billfish caught by the
recreational fishery in the western North Atlantic Ocean during the 1 year
period, May 1, 1977 to April 30, 1978. The survey assumed that all fishing
done in these waters by recreational fishermen would be done from boats
20-65 feet long (except Florida where 18 and 19 foot boats were included)
and registered in an Atlantic or Gulf of Mexico coastal state, Puerto Rico,
the U.S. Virgin Islands, or with the Coast Guard as a documented vessel.
Whenever possible, boats were eliminated from the population based on
propulsion and use codes as reported in the boat registration files. A
sample of 56,241 boats was selected by systematic random sampling from
a stratified population of 389,930 boats.

Questionnaires requesting billfish and shark catch and effort information
were sent to the selected 56,241 registered boat owners on June 8, 1978.
Approximately 3 weeks after the first mailing, a second mailing of about
33,200 questionnaires was sent to those people not responding to the
first mailing. In August, telephone interviews were conducted with a
subsample of the nonrespondents to the mail questionnaire. A brief
summary of the results of this survey follows:

Billfish

1. The estimate of the total number of billfish caught is 85,869 $\pm$ 15,502
    at the 95% confidence limit (CL).

2. Estimates of the total number of each billfish species caught and
    boated (number caught minus number released) are:

Species	Caught	Boated
Blue Marlin	6,745 $\pm$ 1,610 at 95% CL	2,452 $\pm$ 536 at 95% CL
White Marlin	15,649 $\pm$ 3,450 at 95% CL	4,787 $\pm$ 838 at 95% CL
Sailfish	60,008 $\pm$ 14,994 at 95% CL	15,699 $\pm$ 3,970 at 95% CL
Spearfish	467 $\pm$ 324 at 95% CL	397 $\pm$ 306 at 95% CL
Swordfish	3,000 $\pm$ 946 at 95% CL	2,344 $\pm$ 860 at 95% CL
Totals	85,869 $\pm$ 15,502 at 95% CL	25,679 $\pm$ 4,192 at 95% CL

3. Estimates of the number of billfish caught in each of the areas described in the survey are:

Virginia and Northward	8,709 ± 1,938 at 95% CL
North Carolina to Florida	9,411 ± 2,936 at 95% CL
Florida East Coast & Keys	51,307 ± 14,684 at 95% CL
Gulf of Mexico	10,832 ± 2,984 at 95% CL
Puerto Rico and the U.S. Virgin Islands	1,444 ± 1,372 at 95% CL
Other Waters	4,168 ± 1,250 at 95% CL

4. Four methods used to estimate the number of boats in the billfish fishery produced estimates of 17,373, 17,392, 19,737 and 21,980 boats.

5. Three methods used to estimate the number of days fished for billfish produced estimates of 247,743, 296,100 and 298,797.

6. The average number of days fished for billfish per boat was 14.4.

7. The average number of billfish caught per day fished was 0.29.

8. The average number of billfish caught per boat was 4.2.

Sharks

1. Estimate of the number of sharks (over 20 pounds) caught is: 230,423 ± 44,050 at 95% CL.

2. Shark catch estimates by area fished are:

Virginia and Northward	124,226 ± 40,262 at 95% CL
North Carolina to Florida	16,292 ± 8,050 at 95% CL
Florida East Coast & Keys	40,184 ± 12,086 at 95% CL
Gulf of Mexico	46,405 ± 10,348 at 95% CL
Puerto Rico and the U.S. Virgin Islands	776 ± 640 at 95% CL
Other Waters	2,536 ± 1,032 at 95% CL

3. Four methods used for estimating the number of boats in the shark fishery produced estimates of 13,986, 14,139, 18,773 and 19,730.

4. Three methods used to estimate the number of days fished for sharks produced estimates of 146,838, 190,432 and 213,738.

5. The average number of days fished for sharks per boat was 10.6.

6. The average number of sharks caught per day fished was 1.2.

7. The average number of sharks caught per boat was 12.8.

TABLE OF CONTENTS

PAGE

LIST OF TABLES

LIST OF FIGURES

SURVEY OF THE RECREATIONAL BILLFISH AND SHARK FISHERIES

MAY 1, 1977 TO APRIL 30, 1978

INTRODUCTION

Since passage of the Fishery Conservation and Management Act of 1976

(Public Law 94-265), the National Marine Fishery Service (NMFS) has been

responsible for supporting the newly established Regional Fishery Management

Councils in developing Fishery Management Plans (FMP's) to manage the

fisheries within the Fishery Conservation Zone (FCZ). FMP's describe how a

fishery resource will be managed within the FCZ, which includes water from the

states' territorial sea to 200 miles offshore.

The South Atlantic Council is the lead council responsible for the

development of the Billfish FMP. The Southeast Fisheries Center (SEFC) of

NMFS recognized that only very limited data were available on the total

recreational catch of billfish and sharks, and that a survey could provide

additional data. NMFS was already developing a National Marine Recreational

Fishery Survey that would provide recreational catch data on certain finfish

and shellfish. Because catching billfish is a relatively rare event, the

national survey is not expected to provide adequate data for these species.

Therefore, the Technical and Information Management Services (TIMS) of the

SEFC designed and conducted a survey to collect data on billfish and sharks.

Described in this report is the survey design, survey results and data

analyses of the recreational billfish survey. It is estimated that about five

man-years of effort were expended in conducting this survey.

The principal objective of the billfish survey was to estimate the total recreational catch of billfish in the western North Atlantic during a 12-month period, May 1, 1977 to April 30, 1978.

Secondary objectives were to:

1. Collect data on the recreational catch of sharks larger than 20 pounds.

2. Collect effort data for both the billfish and shark fisheries.

3. Collect data on tournament and nontournament catch of both billfishes and sharks.

4. Identify characteristics of the fisheries that may aid in designing future surveys.

5. Collect the above data from the following areas (Figure 1):

    a. Virginia and northward

    b. North Carolina to Florida

    c. Florida East Coast and the Florida Keys

    d. Gulf of Mexico

    e. Puerto Rico and the U.S. Virgin Islands

    f. Other waters (primarily the Bahamas)

SURVEY REQUIREMENTS

Population Description

A complete list of individuals participating in recreational billfishing in the study area does not exist, and in order to identify a target population to meet the objectives of this recreational billfish survey, two assumptions

VIRGINIA
&
NORTHWARD

NORTH CAROLINA
TO
FLORIDA

FLORIDA EAST COAST
AND
FLORIDA KEYS

GULF OF MEXICO

OTHER
WATERS

PUERTO RICO
AND
U.S. VIRGIN ISLANDS

NH
MA
CT
NY
RI
NJ
MD
VA
NC
SC
MS
AL
GA
TX
LA
FL
PR
VI

3
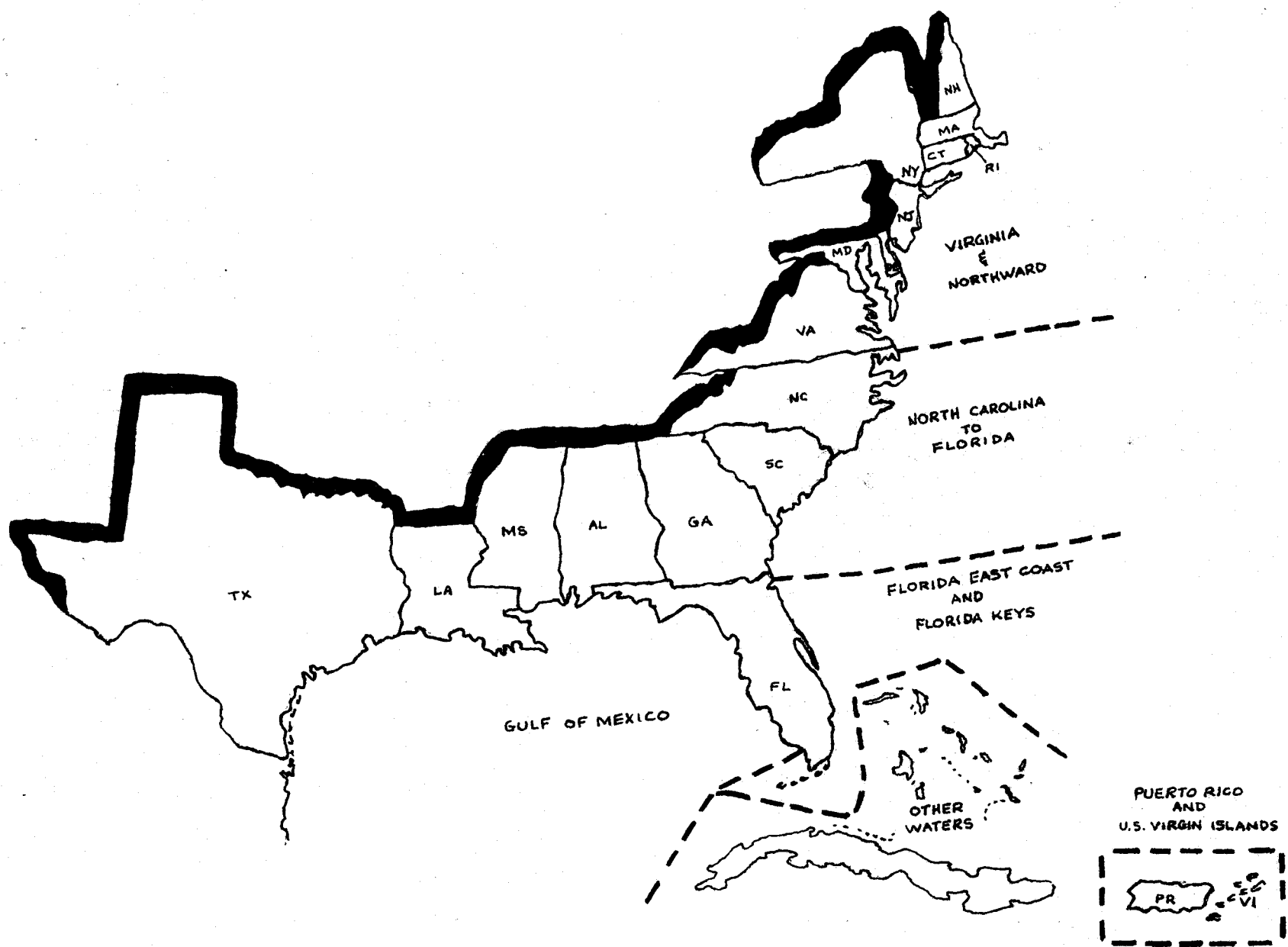
were made: 1) to go fishing for billfish one must use a boat of the proper size and type; 2) all boats used in fishing for billfish recreationally in the study area would be registered in an Atlantic or Gulf Coastal State of the United States, with the U.S. Coast Guard as a documented vessel, in Puerto Rico, or in the U.S. Virgin Islands.

If the boat registration files from these sources were combined, it was assumed that virtually all U.S. recreational boats capable of billfishing in the study area would be identified, and therefore it would be possible to identify the target population. Boats were determined to meet the requirements of this survey if they were:

1.   registered in a coastal state of the United States from Texas to New Hampshire, Puerto Rico, or the U.S. Virgin Islands; (Preliminary investigations determined that no recreational billfishing is conducted off Maine, so its registration file was not included.)

2.   registered by the U.S. Coast Guard as a documented vessel and having a home port somewhere within the study area;

3.   20-65 feet in length (except in Florida where the Gulf Stream is close to shore in certain areas, thus enabling smaller boats (18-19 feet) to fish for billfish);

4.   powered by other than sail;

5.   not identified as commercial fishing boats, such as a shrimper or other trawler.

This target population, therefore, consisted of 20 separate boat registration files: one from the U.S. Coast Guard, one from Puerto Rico, one from the U.S. Virgin Islands, and one each from 17 coastal Atlantic States. For the remainder of this report, all of these files will be referred to

collectively as "state files."

Acquisition of these files proved to be no small task. Principal problems encountered in this undertaking were primarily related to privacy considerations and state laws. Other problems affecting building a uniform file included:

1. Twenty different registration formats.

2. Eighteen different types of data processing systems, and two nondigitized files.

3. Nonstandard methods of boat registration.

4. Nonstandard definition of use codes.

5. Nonstandard use of propulsion codes.

The two files not available in digitized form were from Delaware and Puerto Rico. A computer printout of the Delaware file was made available to TIMS at the Dover Office of the Delaware Department of Natural Resources and Environmental Control, Division of Fish and Wildlife. The Puerto Rican file consisted of actual registration forms and was available at the San Juan Office of the Puerto Rican Port Authority. In both cases, systematic random sample of 10% of the boats between 20-65 feet was drawn by hand and later digitized. The other 18 files were acquired on computer tape and converted to run on TIMS' computer equipment.

Survey Design

It is possible to collect data on many aspects of any fishery. Because the major objectives of this survey were to collect catch and effort data to support development of billfish and shark FMP's, it was decided that the most relevant data needed were: 1) number of fish caught, released, and boated by

species, 2) location of catch, 3) days fished, 4) boat size, 5) identification of sharks by species, 6) number of fish reported caught in tournaments, and 7) type of boat used (charter or noncharter).

To gain information about a specified population it would be too expensive and time-consuming to canvass the entire population. To draw a valid conclusion about a population, a representative sample of a population can be selected. Some of the sampling techniques available for selecting a representative sample of a population are: simple random sampling, systematic random sampling, cluster sampling, stratified sampling, and multistage sampling. Regardless of the techniques used, it is important that there be no selective factor in drawing the sample, and that there be no selective factor present among those responding. The most common procedures for collecting statistical data are: direct observation, personal interview, and mail questionnaires.

In determining the methodology to be used in executing the billfish survey the following points were considered:

1. Although, direct observation produces more accurate data, it is neither practical nor feasible for this study, because the information desired is retrospective, the target population covers too large a geographic area, and the cost is prohibitive.

2. The personal interview procedure may provide for a more complete response to be obtained, but the cost and time to administer is large. To conduct a face-to-face interview, a large staff of trained interviewers is needed and a procedure for maintaining supervision is required. To conduct a personal interview via telephone also requires a trained staff of interviewers, phone

equipment, and a procedure for supervision.

3.   The mail questionnaire procedure is the quickest and least expensive, but usually results in a large nonresponse rate.

4.   The method to be used must require the least amount of time and money to obtain a given degree of reliability.

The mail questionnaire procedure, besides being quicker and less expensive, is used in many surveys because accurate data can be collected; more persons can be contacted initially without increasing cost; respondents can consult records; and the questionnaire can be completed at the respondent's convenience. The principal problem encountered in using this survey procedure is that many people do not respond to mail questionnaires. Also the respondent may not understand the questions or will knowingly or otherwise answer incorrectly.

Cost and time comparisions were made for doing all data collecting by telephone against collecting the initial data by mail with a telephone follow-up of nonrespondents. Telephone numbers were not part of the boat registration files; therefore, extra time and money would be required to obtain these numbers. A multistage sampling technique was used in this survey to minimize time and cost, i.e., an initial mail questionnaire with a follow-up telephone interview of nonrespondents. Two mailings of the questionnaire were made; the first went to every sample unit selected, and the second went to nonrespondents from the first mailing. Additionally, the telephone follow-up procedure was used because it was not known if the answers of those responding to the mail questionnaire were representative of those not responding.

Type of Sample

The population for this survey consisted of potential billfishing boats registered on the 20 state boat registration files already described. It was thought that duplication may have existed between the U.S. Coast Guard documented vessel file and other state files. To test this, about 200 boats registered in state files were searched for in the U.S. Coast Guard file with only one being found. This seems reasonable because law requires only one type of registration, and duplicate registration would cost the boat owner extra money. It was assumed that duplication among other state files would also be insignificant. The existence of duplicate records within a file was also assumed to be insignificant. If a boat owner had more than one boat selected in the sample, a questionnaire was mailed for each boat.

According to NMFS researchers familiar with billfish tournament and dock sampling, certain size boats were more likely to participate in the billfish fishery. Based on their knowledge of the fishery, the population of potential billfishing boats was stratified into five size classes: 1) 18-19 foot boats registered in Florida, 2) 20-25 foot, 3) 26-34 foot, 4) 35-45 foot, and 5) 46-65 foot boats. It was felt that stratifying the population by boat size class would reduce the within stratum variance to a minimum because boats with similar billfishing potential would be sampled together. Therefore, stratification was used to increase the precision of the final estimate of total catch. Because each state file was obtained separately and each had unique characteristics and because samples from Puerto Rico and Delaware had to be pre-selected by hand, it was decided to additionally stratify the population by state of registration.

Each unit in the sampling frame was identified by a number which allowed
individual responses to be weighted according to their probability of
selection. Each unit was assigned a _nine_ digit code. The first two digits
were letters that identified state of registration or stratum (Table 1); the
second six digits were numbers which identified the individual within a state;
the last digit was response a code used to identify the type of response,
i.e., "A" identified response to the first mailing, "B" identified response to
the second mailing, and "P" identified response by telephone.

The initial sample design was based on several assumptions: that
respondents could recall their fishing activity for the year; the frequency of
participation in the sport fishery for billfish would be low, and the actual
catch of billfish would be a rare event; the response would be related to the
individual boat selected in the sample; the experience of those responding by
mail or telephone would be representative of the the entire population and the
expected response rate to the mail survey would be about 50%. Before
acquisition of all state files, it was necessary to make other assumptions
about the population. We estimated that there were about 2 million
recreational boats in the area to be studied and that about 20% of these could
be classified as capable of billfishing. We further estimated that about 5%
of the boats in the frame would actually go billfishing and that about 20% of
these boats would have a catch of a billfish. Therefore, it was estimated
that the proportion of boats in the population that would have a catch of
billfish was about 1%. Thus the objective was to select a random sample that
would achieve, with 95% confidence, an estimate with an error not to exceed
10% of the true value. That is, if repeated sampling was done under the same
conditoons, 95 out of 100 times the estimate would be within 10% of the true

9

population value. The sample size (n) is based on the following formula:
(Cochran)[1]:

$$n = \frac{\dfrac{t^2 PQ}{d^2}}{1 + \dfrac{1}{N}\left(\dfrac{t^2 PQ}{d^2} - 1\right)}$$

P = expected incidence in the population

Q = 1 - P

t = standard normal deviate value at the 95% confidence level

d = difference between the sample estimate and the population value

N = estimated number population of boats

Thus, for this survey:

$$n = \frac{\dfrac{(2^2)(.01)(.99)}{(.001)^2}}{1 + \dfrac{1}{400,000}\left(\dfrac{(2^2)(.01)(.99)}{(.001)^2} - 1\right)} = 36,033$$

Based on these assumptions and sample design, a sample size of about
36,000 boats would be needed to make estimates of catch provided there were a
100% response rate. Because a 100% response rate was not expected, the
following factors were important in determining the final sample size: 1) the
catch of billfish is a rare event, 2) the completeness of the sampling frame,
3) the associated cost of processing response, 4) the expected response rate
to both mailings, and 5) the cost for obtaining and processing data for
nonrespondents. To obtain a final sample size of 36,000, an initial sample
size of approximately 56,000 was selected to allow for all factors reducing
response rate. The sample size of 56,000 boats was proportionally allocated
to each state, and a sampling fraction was determined for each boat class
within a state. The sampling fraction was derived on the basis of taking a

1 Cochran, W. G. 1977. Sampling Techniques. p.75. 3rd
   edition. New York, John Wiley and Sons.

sample three times as large from the strata that were expected to have the highest proportion of catch (boats 26-45 feet) than from the strata expected to have a lower proportion of catch (boats 18-25 and 46-65). If the number of boats in a stratum was small, the sampling fraction was adjusted slightly to insure an adequate sample selection. The same basic procedure in sample allocation was used in both the initial selection for mailing and for subsampling of nonrespondents in the telephone survey.

Selection of Subsample

The size of the subsample to be used in the follow-up telephone survey was based on the time required to obtain responses, cost to obtain responses, and the minimum estimated number of responses that would produce reliable estimates. With cost and time as the major factors, a subsample of about 30% of the nonrespondents was selected. The subsample was drawn from those units not responding to the mailing plus all questionnaires returned undelivered. Nonrespondents from outside the continental United States were omitted from the telephone survey because of prohibitive costs in calling these areas.

QUESTIONNAIRE DESIGN

The questionnaire to be used in the recreational billfish survey had to fulfill the following requirements:

1. Be easy to understand and simple to complete.

2. Request all required data on billfishing and/or shark fishing by geographical area.

3. Be easily adaptable for use in the phone interview portion of the survey.

4. Provide a self-addressed, stamped return envelope.

5. Provide a letter identifying the study, need for data, and privacy considerations of the respondents.

6. Identify the boats sampled in the survey both on the mailout (for delivery purposes) and on the enclosed questionnaire (for data entry and processing purposes).

7. Be compatible with automated addressing procedures.

The Letter of Introduction (Figure 2) includes the individual's address and identifying survey number. The address and survey numbers were printed on the outgoing envelope over an imbedded piece of carbon paper, which transferred the information to the actual survey form to be returned by each respondent. The questionnaire portion of the survey package (Figure 3) was printed on the opposite side of the Letter of Introduction. Therefore, every response received had the individual's survey number typed on the questionnaire, thus eliminating the possibility of error in identifying and matching an individual's response.

Special consideration was given to the survey forms sent to Puerto Rico because the native language is Spanish. A Spanish letter of introduction and questionnaire accompanied the standard English form. Each respondent was asked to complete either the English or Spanish form.

A pretest of the English questionnaire was conducted at four marinas in the Miami area. Eight boat owners were selected to complete the questionnaire. Interviewers were instructed not to help the respondents complete the forms but to record any questions asked or comments made regarding the form. The pretest resulted in a few minor word changes in the questionnaire, but no significant problems were encountered.

Figure 2

LETTER OF INTRODUCTION

BILLFISH SURVEY

U.S. DEPARTMENT OF COMMERCE NATIONAL MARINE FISHERIES SERVICE, NOAA SOUTHEAST FISHERS CENTER

Dear Boat Owner:

Since the extension of U.S. jurisdiction to the 200 mile limit and establishment of Fishery Management Councils, it has become essential to obtain as much information as possible about our coastal resources to support the Councils in their development of Fishery Management Plans. These Fishery Management Plans are being developed to ensure the continued abundance of our coastal resources for use by the American fisherman. The National Marine Fisheries Service (NMFS) has been tasked with conducting a survey of recreational fishing for billfish and sharks along the Gulf of Mexico and Atlantic coasts of the United States, and the Caribbean fishery around Puerto Rico and the U. S. Virgin Islands. Information gained by this survey will support many endeavors, including the South Atlantic Council in their plans for refining the Billfish Fishery Management Plan.

Because we can survey only a portion of the fishing population, the answers received from participants represent the answers of many. For this reason, it is very important that you answer all questions as accurately as possible. Your voluntary participation in this survey is extremely important and greatly appreciated. The information you provide is confidential and will be used for statistical purposes only. Please complete this questionnaire and return it to us as soon as possible.

OMB# 41-s78028   EXP 6-78
    SC012345A

John Doe
Box 9999
123rd Street
Exampleville, Fl. 98765

NOAA 88-930

Thank you very much for
    your cooperation.
Sincerely,

Dr. Richard J. Berry
Acting Director
Southeast Fisheries Center

Figure 3

QUESTIONNAIRE

BILLFISH SURVEY

1. DURING THE 12 MONTH PERIOD FROM MAY 1, 1977 THROUGH APRIL 30, 1978, DID YOU OR ANYONE ELSE USE YOUR BOAT TO FISH FOR BLUE MARLIN, WHITE MARLIN, SAILFISH, SPEARFISH, SWORDFISH, OR LARGE SHARKS?   ☐ YES   ☐ NO
(IF NO GO TO 4)

2. PLEASE INDICATE ON THE TABLE BELOW THE NUMBER OF FISH BY SPECIES AND AREA THAT WERE CAUGHT (CAUGHT=BOATED+RELEASED) FROM YOUR BOAT DURING THE TIME PERIOD ABOVE. ALSO, PLEASE INDICATE DAYS FISHED WHETHER SUCCESSFUL OR NOT.

FISHING AREA	BLUE MARLIN		WHITE MARLIN		SAILFISH		SPEARFISH		SWORDFISH		SHARKS OVER 20 LB.*		INDICATE NUMBER OF DAYS FISHED BY AREA FOR	
	NUMBER CAUGHT	NUMBER RELEASED	NUMBER CAUGHT	NUMBER RELEASED	NUMBER CAUGHT	NUMBER RELEASED	NUMBER CAUGHT	NUMBER RELEASED	NUMBER CAUGHT	NUMBER RELEASED	NUMBER CAUGHT	NUMBER RELEASED	BILLFISHES	SHARKS
VIRGINIA & NORTHWARD														
N. CAROLINA TO FLORIDA														
FLA. EAST COAST & FLA. KEYS														
GULF OF MEXICO														
PUERTO RICO & U.S. VIRGIN ISLANDS														
OTHER WATERS														

(left margin: U.S. WATERS)

*IF ABLE TO IDENTIFY SPECIES OF SHARKS, PLEASE ESTIMATE NUMBER CAUGHT BY SPECIES: _____

3. PLEASE INDICATE THE FOLLOWING:
  A. BOAT LENGTH_____FEET
  B. WAS YOUR BOAT USED PRIMARILY FOR CHARTERING
    DURING THE LAST 12 MONTHS? ☐ YES ☐ NO

  C. NUMBER OF FISH LISTED ABOVE THAT WERE CAUGHT IN A
    TOURNAMENT: BILLFISH_____SHARKS_____

4. THANK YOU VERY MUCH FOR YOUR PARTICIPATION IN THIS SURVEY. PLEASE RETURN THIS QUESTIONNAIRE TO US IN THE ENCLOSED ENVELOPE EVEN THOUGH YOU MAY NOT HAVE USED YOUR BOAT FOR BILLFISHING DURING THAT PERIOD. PLEASE INDICATE IF YOU WOULD LIKE TO RECEIVE A COPY OF THE FINAL RESULTS OF THIS SURVEY WHEN AVAILABLE. ☐ YES ☐ NO

QUALITY CONTROL AND DATA COLLECTION

Emphasis was placed on quality control throughout every phase of the recreational billfish survey. All computer programs written during the project were thoroughly tested before use, and all products of computer programs were checked to ensure their correctness. Most quality control of respondent information involved use of the survey numbers assigned to each individual. In addition to the 8-digit survey number used to identify each respondent, a different 1-digit code was assigned to all first mailings, second mailings, and phone samples. This ensured that only the first response of any individual was used during data analysis. Quality control on data entry used computer checking techniques that aid in reducing entry errors. Additionally, if responses of people who fished were not fully understood or were suspect (i.e. outliars) the respondents were contacted by telephone to ensure proper recording of their data. Figure 4 is a general flow chart summarizing the data handling procedures as responses were received.

Data collection consisted of two mailings of the questionnaire package and a telephone contact of a subsample of nonrespondents. The first mailing consisted of 56,241 survey questionnaires sent on June 8, 1978. As each response was received, the survey number identifying the respondent was entered into the computer. Approximately 3 weeks after the first mailing, a second mailing of about 33,200 questionnaires was sent to those people not responding to the first mailing.

In early August the subsample of nonrespondents was selected for the phone survey. The telephone survey was conducted by Copley International

Figure 4

DATA HANDLING FLOW CHART
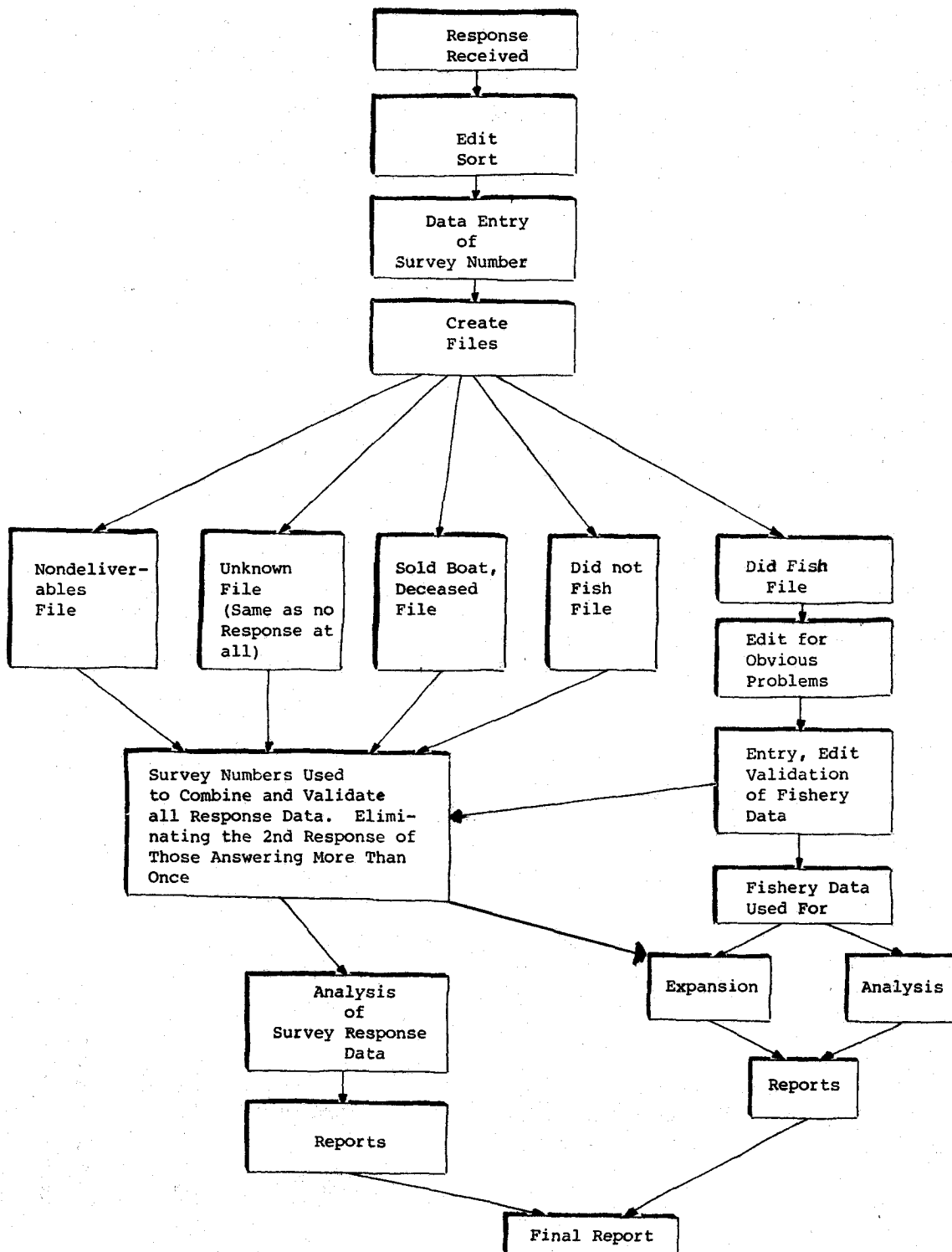
Corporation, LaJolla, Calif., from August 8 to August 25, 1978. Telephone interviewers were given a dialogue sheet, which was basically a verbalization of the mail questionnaire. Respondent data were recorded directly on mail questionnaire forms, which had printed on them the address and survey numbers of the respondent. This ensured a means of quality control for data entry of the phone survey respondent information. Special materials, supervision, and briefings by a NMFS employee were utilized in the telephone survey to ensure quality control. At least one Spanish speaking interviewer was on duty during all interviewing periods. No calls were placed to nonrespondents outside the continental United States.

In late October, data entry was discontinued and the final steps of validating, updating, and merging respondent data were completed. Data expansion, analysis, and further validation continued for the remainder of 1978.

DATA EXPANSION

Historically, it has been observed that nonrespondents often differ from respondents. This survey solved the problem of possible nonrespondent bias by conducting telephone interviews with a subsample of the nonrespondents, thereby characterizing this group.

For data expansion purposes, the population was treated as two strata: those who responded to the mail survey and those who responded by telephone. The two strata are combined to get an estimate of the population. The estimate will be unbiased if responses are obtained from all units in the selected random subsample. Even though there were nonrespondents in the

telephone subsample the responses received are still the most reliable data to characterize the nonrespondents to the mail questionnaire.

Expansion and variance computations were based on a sampling frame which contained a number of boats that were sold or destroyed before sampling (referred to as out-of-scope). To determine the magnitude of this problem, the number of out-of-scope boats in the population was calculated based on respondent information. These numbers were small and because the value of the response for each of the out-of-scope units would be zero, the formulas used here do not differentiate between in-scope and out-of-scope responses. The use of only the in-scope responses did not change the estimated total or the associated standard errors; however, the effectiveness of the sample size was diminished and the variance of the estimate was slightly increased.

Population estimates for the U.S. Virgin Islands and Puerto Rico were based only on responses to the mail survey as no follow-up telephone interviews were conducted in these areas because of prohibitive expense.

Estimates for each stratum were based on the type of response (mail or phone), the response rate, sampling proportion, and the number of boats registered in each stratum. Therefore, the estimated total for a stratum, denoted by $\hat{T}$, is the weighted sample mean multiplied by the stratum size and can be written as:

$$\hat{T} = N \left[\frac{n_1}{n} \bar{y}_{n_1} + \frac{n-n_1}{n} \bar{y}_{m_1} \right]$$

$\hat{T}$ = estimated total per stratum

N = total number of boats registered within a stratum

n = number of boats in the sample within a stratum

n_1 = number of respondents to the mail survey

m_1 = number of respondents to telephone survey

$n-n_1$ = number of nonrespondents to the mail

17

$\bar{y}_{n.}$ = mean number of fish caught by respondents to the mail survey

$\bar{y}_{m.}$ = mean number of fish caught by respondents to the telephone follow-up survey

$\wedge$ = denotes an estimate of the population made from the sample

In other words, the total estimated number of fish caught in each stratum was obtained by multiplying the number of boats registered times the average number of fish caught by all respondents. However, the average number of fish caught by all respondents had to be weighted as to the type of response (mail or phone) and the response rate for each type. This means that mail respondent data were expanded back to that portion of the population they represented, and phone respondent data were expanded back to the remainder, i.e., represented by the mail nonrespondents. Example:

N = 1000 boats registered

n = 200 samples selected

$n.$ = 130 mail respondents

$\bar{y}_{n.}$ = 0.5 fish

$n-n.$ = 70

$\bar{y}_{m.}$ = 0.3 fish

$\hat{T}$ = 1000 ((130/200)(0.5) + (70/200)(0.3))

$\hat{T}$ = 1000 (0.430) = 430 fish

This means that the data for 130 mail respondents represented (130/200) X (1000) = 650 boats in the population and the remaining 350 boats were represented by the data reported by the phone respondents.

Stratum estimates can be summed to obtain various group and total estimates, and their associated variances can be summed to obtain the variances relating to the group and total estimates being calculated. The

18

variance of the total, $\hat{V}(\hat{T})$, can be estimated as:

$$\hat{V}(\hat{T}) = \frac{N(N-n)}{n} S^2 + \frac{N^2 (k-1) (n-n_1)}{n^2} S_2^2$$

where, the first term of the above formula is the estimate of the variance if there had been no nonresponse. The second term represents the contribution to the variance due to the fact that data were collected for only a subsample of the nonrespondents. S^2 is the estimate of the variance in the entire population, and S_2^2 is the variance among those subsampled. The population variance, S^2 may be estimated by:

$$S^2 = \frac{n_1}{n} s_1^2 + \frac{n-n_1}{n} s_2^2 + \frac{n_1}{n} \left(\bar{y}_{n_1} - \bar{y}_{st}\right)^2 + \frac{n-n_1}{n}\left(\bar{y}_{m_1} - \bar{y}_{st}\right)^2$$

Hence the variance may be written as,

$$\hat{V}(\hat{T}) = \frac{N(N-n)}{n}\left[\frac{n_1}{n} s_1^2 + \frac{n-n_1}{n} s_2^2 + \frac{n_1}{n} \left(\bar{y}_{n_1} - \bar{y}_{st}\right)^2 + \frac{n-n_1}{n} \left(\bar{y}_{m_1} - \bar{y}_{st}\right)^2\right] + \frac{N^2 (k-1) (n-n_1)}{n^2} s_2^2$$

where,

$$s_1^2 = \sum^{n_1} \frac{(y_i - \bar{y}_{n_1})^2}{n_1 - 1}$$

$$s_2^2 = \sum^{m_1} \frac{(y_i - \bar{y}_{m_1})^2}{m_1 - 1}$$

$$\bar{y}_{st} = \frac{n_1}{n} \left(\bar{y}_{n_1}\right) + \frac{n-n_1}{n} \left(\bar{y}_{m_1}\right)$$

where, k = the reciprocal of the sampling fraction for the telephone survey.

The variance of the population within a state is the sum of the strata variances. The state population variances can be summed to get an overall estimate of the total variance. The standard error of the estimate is the square root of the variance of the estimate, $\hat{V}(\hat{T})$.

If one assumes the data is normally distributed, it is possible to put confidence intervals on any of the estimates. To obtain 95% confidence limits of an estimate, two standard errors are subtracted from and added to the point estimate. If 99% confidence intervals are desired, three times the standard

error are subtracted from and added to the point estimate. If, for example $\hat{T}$ = 100 and $\hat{V}(\hat{T})$ = 81 then one standard error (SE) = 9, and the 95% confidence interval (CI) = 82 - 118 and the 99% CI = 73 - 127.

RESULTS

The results are divided into two sections, Survey Data Analysis and Fishery Data Analysis. The Survey Data Analysis Section discusses tables and graphs relating to survey design and success of the survey (e.g., population sizes, sample sizes, and response rates); the Fishery Data Analysis Section discusses tables and graphs of fishery data as reported by respondents (e.g., number of fish caught, released, and killed by species, area, boat size, etc.). Presentations of data organized by state of registration are reported alphabetically by state codes (Table 1).

Table 1

States Surveyed

State	Code		State	Code
1. Alabama	AL		12. North Carolina	NC
2. Coast Guard	CG		13. New Hampshire	NH
3. Connecticut	CT		14. New Jersey	NJ
4. Delaware	DE		15. New York	NY
5. Florida East Coast	FE		16. Puerto Rico	PR
6. Florida Gulf Coast	FG		17. Rhode Island	RI
7. Georgia	GA		18. South Carolina	SC
8. Louisiana	LA		19. Texas	TX
9. Massachusettes	MA		20. Virginia	VA
10. Maryland	MD		21. Virgin Islands	VI
11. Mississippi	MS			

Survey Data Analysis

Appendix I contains survey response data organized by state of
registration and gives a complete description of how the data are defined and
calculated. Data are reported by boat size class and totals for four
sections: sample selection data, mail response information, phone survey
information, and total response information. Data for several of the survey
elements within the four sections are presented as histograms on the following
pages. Data grouped by boat size class are reported in Table 2 for
convenience of the reader. These data were obained from Appendix I by summing
individual state data for a given size class over all states. Data for
Delaware and Puerto Rico are not included in analyses by boat size class,
because data on boat size could not be used in sample selection for these two
files. However, data for Delaware/Puerto Rico are included in Table 2.

Table 2

Survey Response Data By Boat Size Class

(Also Delaware/Puerto Rican)

| Statistic | Size Classes | | | | | | |
	18-19*	20-25	26-34	35-45	46-65	DE/PR	TOTAL
Population Size	33275	216104	95293	28756	6362	10140	389930
Sample Size Selected	3697	20393	23965	6715	457	1014	56241
Number of nondeliverables	1152	2303	2500	811	68	107	6941
Number of Respondents	1627	12233	15689	4257	247	552	34605
% Response	44.0	60.0	65.5	63.4	54.1	54.4	61.5
Number Boats Fished	120	765	911	322	21	57	2196
% Who Fished	7.4	6.3	5.8	7.6	8.5	10.3	6.3

* Includes only Florida registered boats

Figure 5 plots the population of boats registered in each of the states surveyed (data from Appendix I). These numbers include only those boats registered that meet this survey's criteria for billfishing capability. If the boats registered in FE (Florida East Coast) and FG (Florida Gulf Coast) are combined, they represent over 79,000 boats, the largest registration of any state. However, an additional size class (18-19 feet) was included in the Florida population and eliminating the 33,275 boats in this class results in New York being the largest.

Figure 6 plots data from Table 2 on population size according to the size of the registered boats. The first size class, 18-19 feet, is small because it includes registrations only from Florida where smaller boats can participate in this fishery because of the proximity of the Gulf Stream. As would be expected, the number of registered boats decreases dramatically as boat size increases. Delaware and Puerto Rico boats are not included in this histogram.

Figure 5

NUMBER OF BOATS IN THE POPULATION BY STATE OF REGISTRATION
(TOTAL = 389,930)

Figure 6

NUMBER OF BOATS IN THE POPULATION BY SIZE CLASS
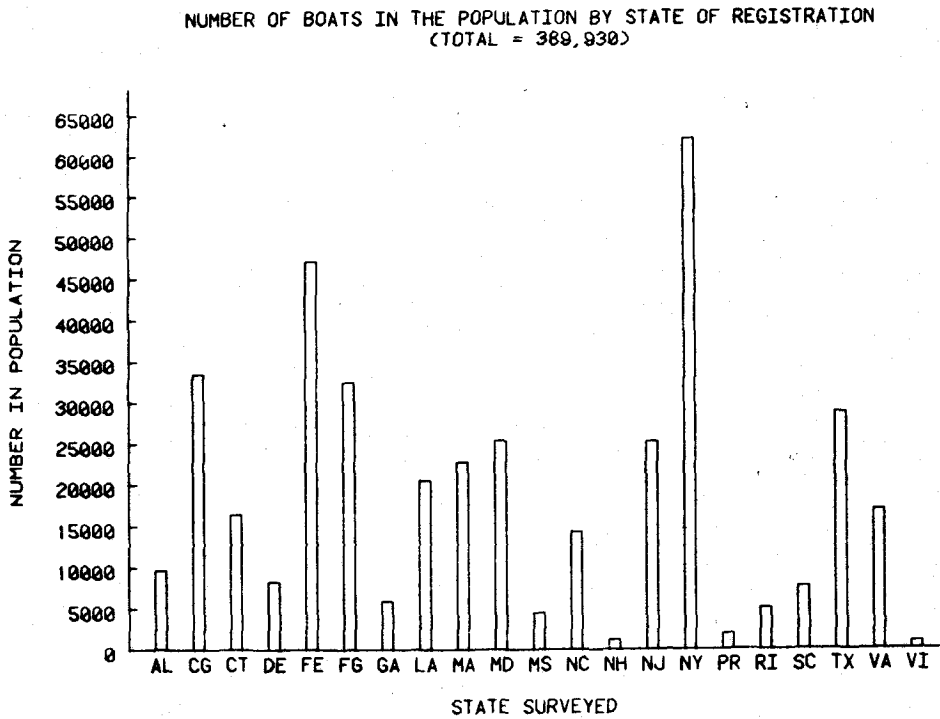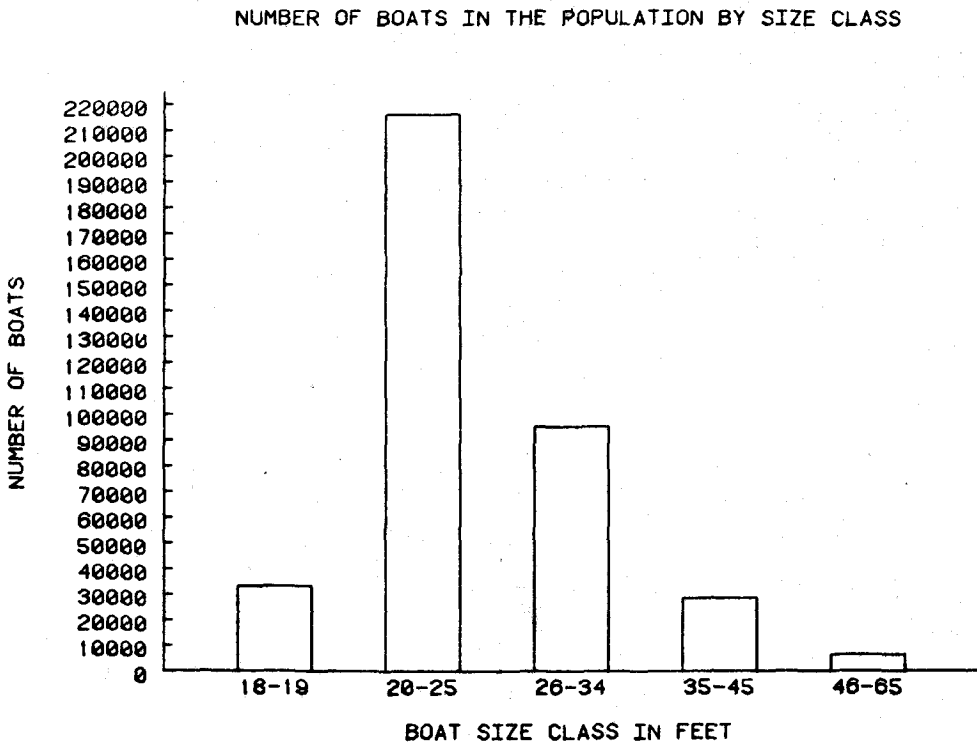
Figure 7 presents the number of boats from each state that were sampled to represent that state in the billfish survey. The average sampling fractions did not vary greatly from state to state, hence the marked similarity to Figure 5.

Figure 8 plots the number of boats sampled for each boat size class. This graph demonstrates the sampling stratification used in this survey. It was suspected that the mid-size class boats had a higher incidence of billfishing activity and, therefore, were sampled more heavily. Comparing Figure 6 with this figure further demonstrates this point.

Figure 7

NUMBER OF BOATS IN THE SAMPLE BY STATE OF REGISTRATION
(TOTAL = 56,241)
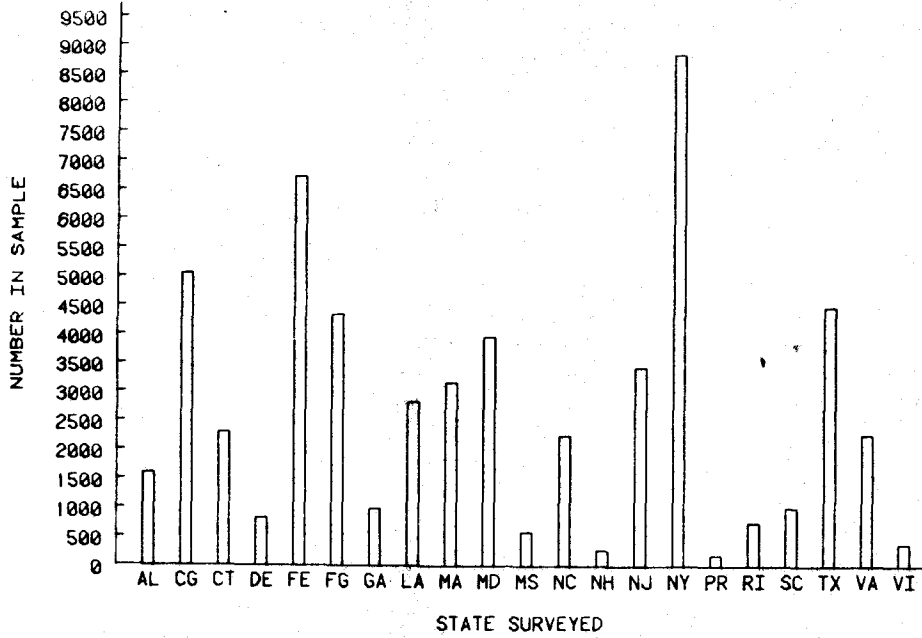
Figure 8

NUMBER OF BOATS IN THE SAMPLE BY BOAT SIZE CLASS
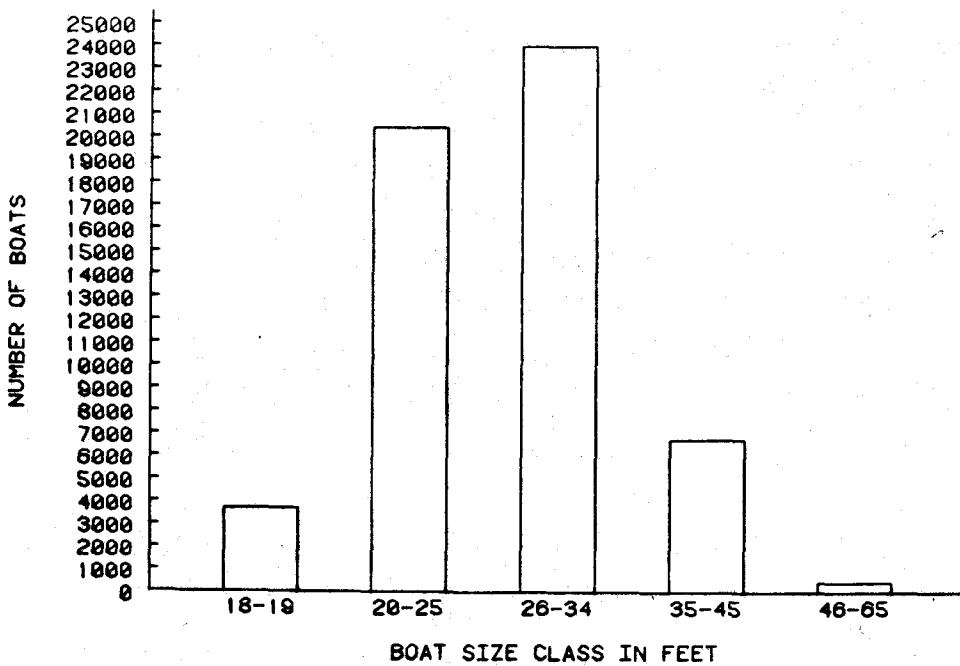
Figure 9 plots the percent responding to the mail questionnaire excluding the number of nondeliverable questionnaires in calculating the percentage. Questionnaires returned undeliverable represent an unsampled portion of the population and therefore can be subtracted from the sample size when calculating percent response. Hence, a more accurate calculation of true mail response rate can be obtained by dividing the number of respondents by sample size minus nondeliverables. Average response rate is 64.3% when using this method.

Figure 10 plots the percent of response to the phone survey. These percentages were calculated by dividing the number of completed interviews by the subsample size selected. Puerto Rico and the U.S. Virgin Islands were not included in the telephone survey. The average percent response was 42.8%. This seemingly low response rate is partially explained by the fact that telephone numbers were available for only 62.5% (4121) of the sample. Using 4121 as the true sample size and recalculating, the average percent response becomes 68.6%.

Figure 9

PERCENT OF RESPONSE TO THE MAIL QUESTIONNAIRE
(EXCLUDING NONDELIVERABLES FROM SAMPLE) BY STATE OF REGISTRATION
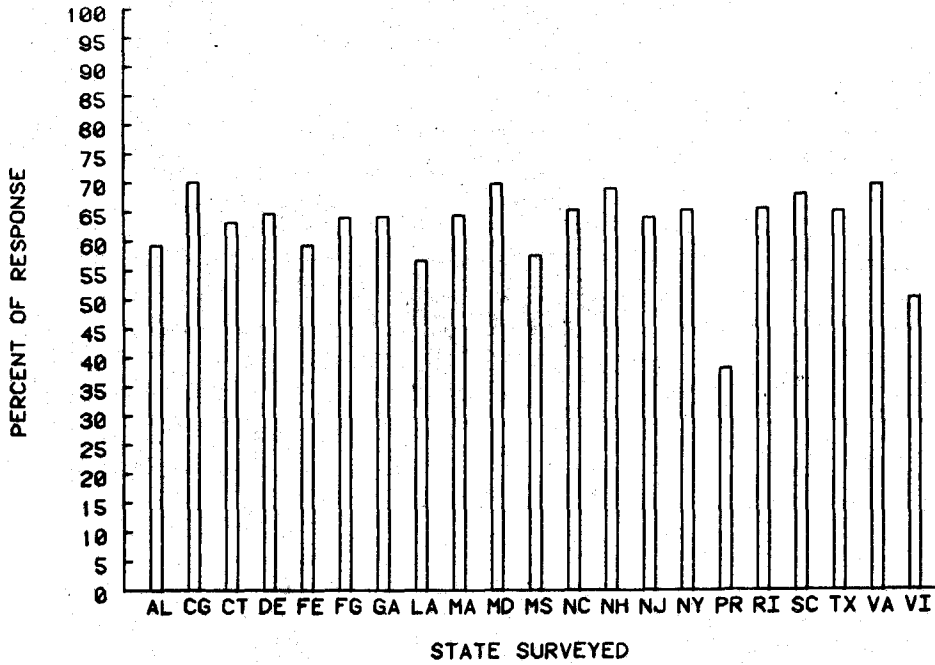
Figure 10

PERCENT OF RESPONSE TO THE PHONE SURVEY
BY STATE OF REGISTRATION
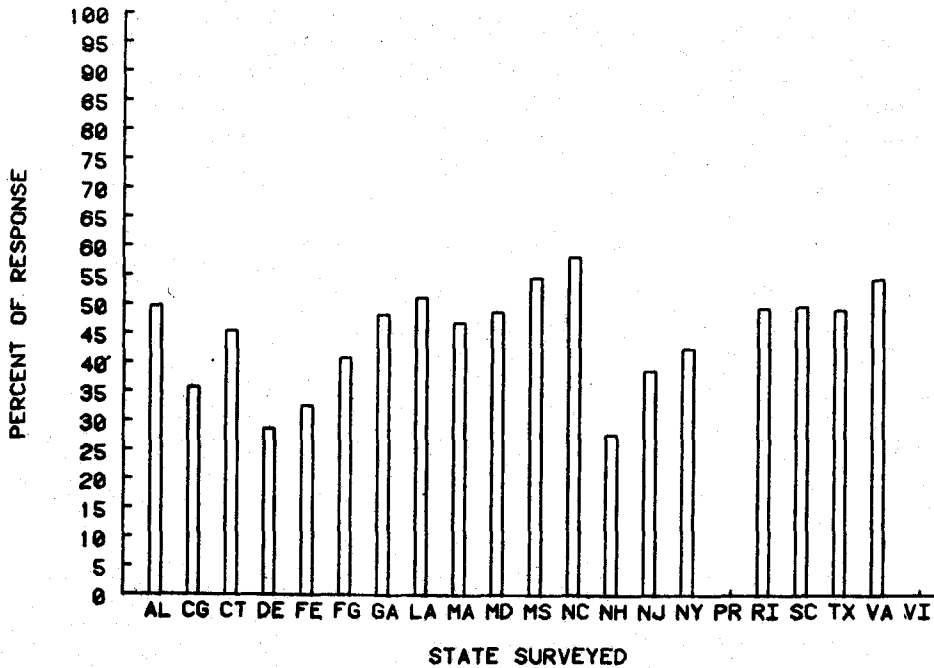
Figure 11 plots the combined (mail plus phone) percent response. These percentages were calculated by adding the number of mail respondents to the number of phone respondents and dividing by the sample size. The average percent response was 61.5%. It was not legitimate, in this case, to calculate a response rate by removing the number of nondeliverables from the sample size because nondeliverables were included in the phone survey.

Figure 12 plots the percent response (mail and phone respondents combined) for each boat size class. The relatively low response rate for size class one (18-19 foot boats) is possibly a result of the relatively high number of nondeliverables reported for this size class.

Figure 11

PERCENT OF RESPONDENTS (MAIL AND PHONE COMBINED) BY STATE OF REGISTRATION

STATE SURVEYED
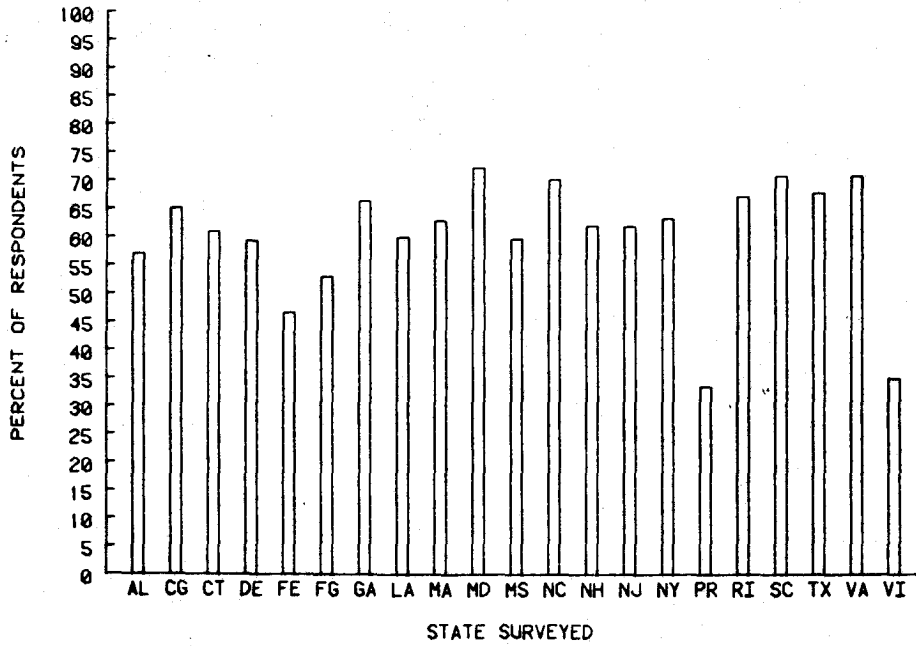
Figure 12

PERCENT OF RESPONDENTS (MAIL AND PHONE COMBINED) BY BOAT SIZE CLASS

BOAT SIZE CLASS IN FEET
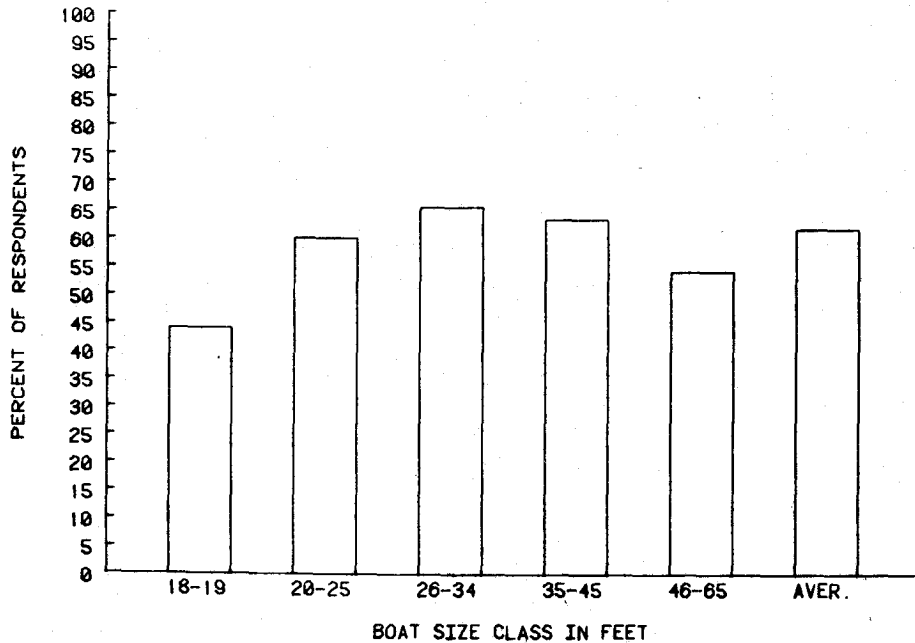
Figure 13 plots the percent of the respondents in each state who fished for billfish or sharks during the study period. The high percentage for Puerto Rico may be an anomaly. Note the relatively high percentage for the Florida East Coast where the Gulf Stream brings excellent billfishing waters close to shore. The average percent of participation in the billfish/shark fishery was 6.3%.

Figure 14 plots the percent of respondents by boat size class who fished for billfish or sharks. The percentage for the smallest size class can be misleading if one does not remember that this size class contains only Florida registered boats where overall fishing percentage was high.

Figure 13

PERCENT OF RESPONDENTS WHO FISHED FOR BILLFISH OR SHARKS
BY STATE OF REGISTRATION
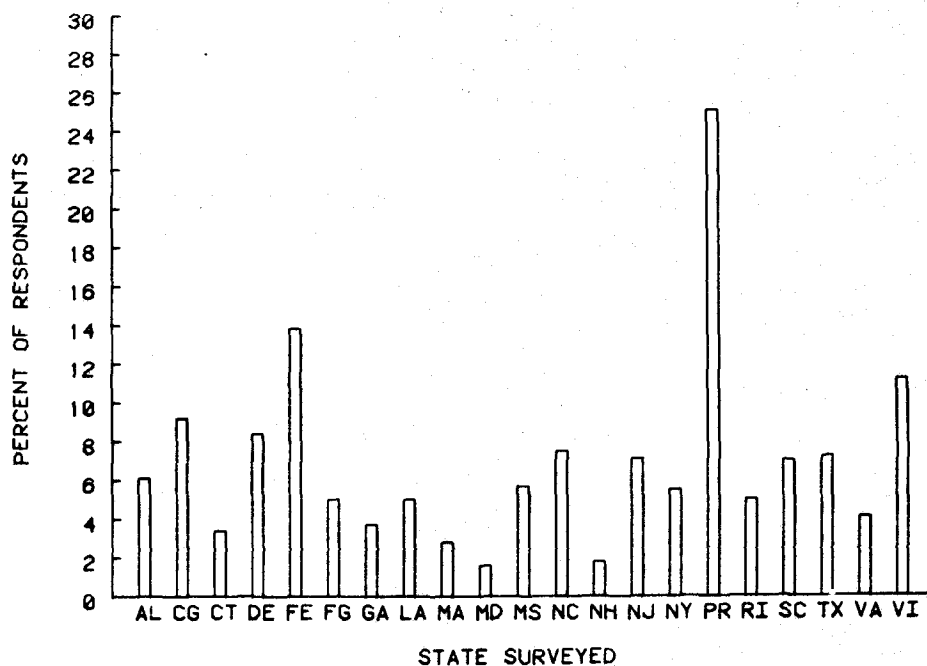
Figure 14

PERCENT OF RESPONDENTS WHO FISHED FOR BILLFISH OR SHARKS
BY BOAT SIZE CLASS
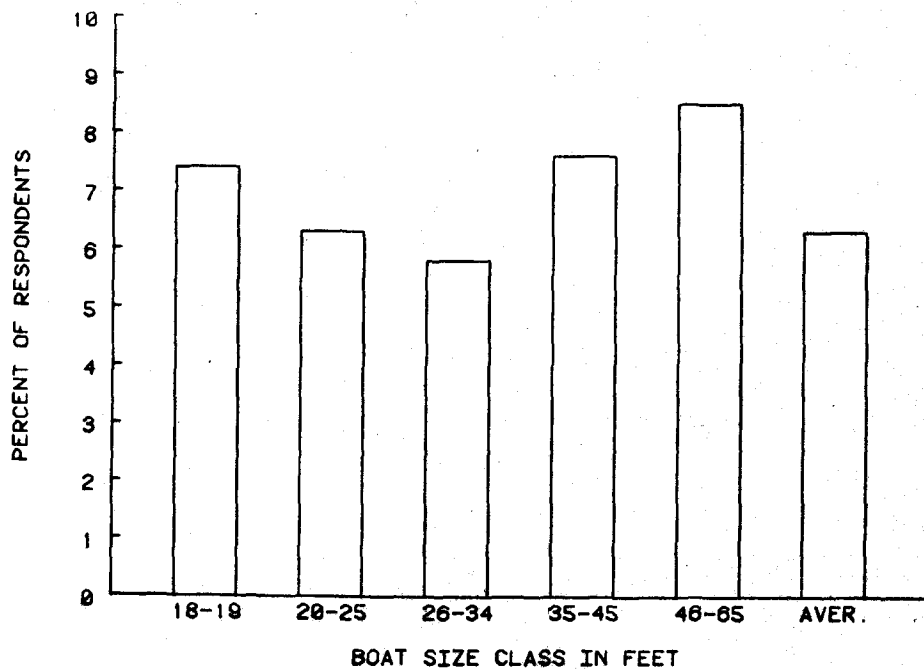
Fishery Data Analysis

Results are presented in two major sections: one on billfish data and one on shark data. Within both of these sections data will be reported on 1) expansion data analyses - including documentation on catch by species, area and boat size; 2) effort data analyses - including estimates of number of boats in the fishery, success rates, and level of effort; and 3) other analyses - including comparisions of charter versus noncharter catch, and tournament versus nontournament catch. Analyses by boat size class do not include the results of Delaware and Puerto Rico in any of the five boat size classes because boat size class data were not used for these two files. However, in most cases, the combined results of Delaware-Puerto Rico (DE-PR) are reported in addition to all size class data. All data presented in graphs and most data in tables are pointed estimates for which standard errors or confidence intervals are not reported. (Calculation of standard errors for all point estimates will be explained in the Expansion Data Analysis Section.) It is possible to identify certain trends and unique features of the data without specifics on standard errors.

Several abbreviations are used in this report in presentation of data on graphs and tables:

Area Abbreviation

V = Virginia and Northward

N = North Carolina to Florida

F = Florida East Coast including the Florida Keys

G = Gulf of Mexico

P = Puerto Rico and the U.S. Virgin Islands

O = Other waters in the western North Atlantic Ocean

Boat Size Class Abbreviations

1 = 18-19

2 = 20-25

3 = 26-34

4 = 35-45

5 = 46-65

6 = No size class available, i.e., all Delaware and Puerto Rican boats
combined.

Species/Catch Abbreviations

BF = Billfish (all species surveyed)

BM = Blue Marlin

WM = White Marlin

SA = Sailfish

SP = Spearfish

SW = Swordfish

SH = Sharks

 C = Caught (includes all fish whether released or kept)

     i.e. BMC = Blue Marlin Caught

 R = Released (includes only fish not kept)

 B = Boated (includes only fish kept) i.e. BMB = BMC - BMR

Billfish Expansion Data Analyses

Appendix II contains a detailed summary report of expansion data for all
species surveyed by boat size class and area. Data in Appendix II were
generated from computer programs that rounded data to whole numbers after all
calculations were performed. This results in small differences in some of the

totals reported in tables. Data used in the remainder of this section have been taken from Appendix II and are usually reported as point estimates only. The reader may calculate any of the standard errors associated with the point estimates reported by summing the variances of the input data and finding the square root of the total. (An example is provided in Appendix II.) 95% and 99% confidence intervals can be calculated for point estimates by using the methods previously described in this report.

Data on numbers of fish caught have been summarized by species, boat size, and area fished and are presented in tables and histograms in this section. Data on numbers of fish released and boated by boat size and area will not be presented in the form of tables and histograms because of the sheer quantity of data. Estimates of the number of each billfish species caught, released, and boated in the study area during the study period, including 95% confidence intervals, are presented in Table 3. Figures 15 and 16 plot these data to demonstrate the disposition of catch for each of the species.

Table 3

Catch Estimates for Billfish

Species	Number Caught	95% CI	Number Released	95% CI	Number Boated	95% CI	% of Catch Released	% of Catch Boated
Blue Marlin	6,745	5,135 – 8,355	4,293	2,901 – 5,685	2,452	1,916 – 2,988	63.6	36.4
White Marlin	15,649	12,199 – 19,099	10,862	7,986 – 13,737	4,787	3,949 – 5,625	69.4	30.6
Sailfish	60,008	45,014 – 75,002	44,310	30,676 – 57,944	15,699	11,729 – 19,669	73.8	26.2
Spearfish	467	143 – 791	70	16 – 124	397	91 – 703	15.0	85.0
Swordfish	3,000	2,054 – 3,946	656	274 – 1,038	2,344	1,484 – 3,204	21.9	78.1
Totals	85,869	70,367 – 101,371	60,191	46,183 – 74,199	25,679	21,487 – 29,871	70.1	29.9

Figure 15 plots the estimated number of fish that were caught, released, and boated for each species of billfish. The number boated (or killed) is equal to the number caught minus the number released. It is known that the recreational catch of a spearfish is an exceptionally rare event, and this data demonstrates that fact. However, the 95% confidence intervals associated with the point estimates are rather broad, and the reader is cautioned about making conclusions based on these data.

Figure 16 plots the percent of the estimated total catch of each species of billfish that were released and boated. The release rates for blue marlin, white marlin, and sailfish appear to be very realistic, showing that the more highly prized and rarely caught blue marlin appears to be released less often than the white marlin, which appears to be released less often than the relatively abundant sailfish. The very low release rate for spearfish may be a result of the extremely low incidence of this fish in the total catch. It seems reasonable that someone capturing this extremely rare species (in the recreational fishery) would be more likely to bring the fish back to the dock for mounting or display. However, the release rate for swordfish, although apparently much lower than the marlins, is still surprisingly high. This species is highly prized for its excellent food value and market price. Examination of the raw data showed that out of 112 people reporting catching swordfish, 25 of them (22.3%) also reported releasing at least one swordfish. Several factors may be causing this relatively high release rate. Because of its good market price, swordfish might be sold by recreational fishermen who are reluctant (possibly because of IRS) to admit receiving payment for a sportfish. It is also possible that a number of the released swordfish were very small and therefore of little value for food or market. Additionally, there may have been misidentification problems on the part of some respondents. Finally, the occurrence of improperly recorded response data can not be ruled out entirely.

Figure 15

ESTIMATED NUMBER OF ALL BILLFISH SPECIES SURVEYED WITH RESPECT TO THE DISPOSITION OF THE CATCH
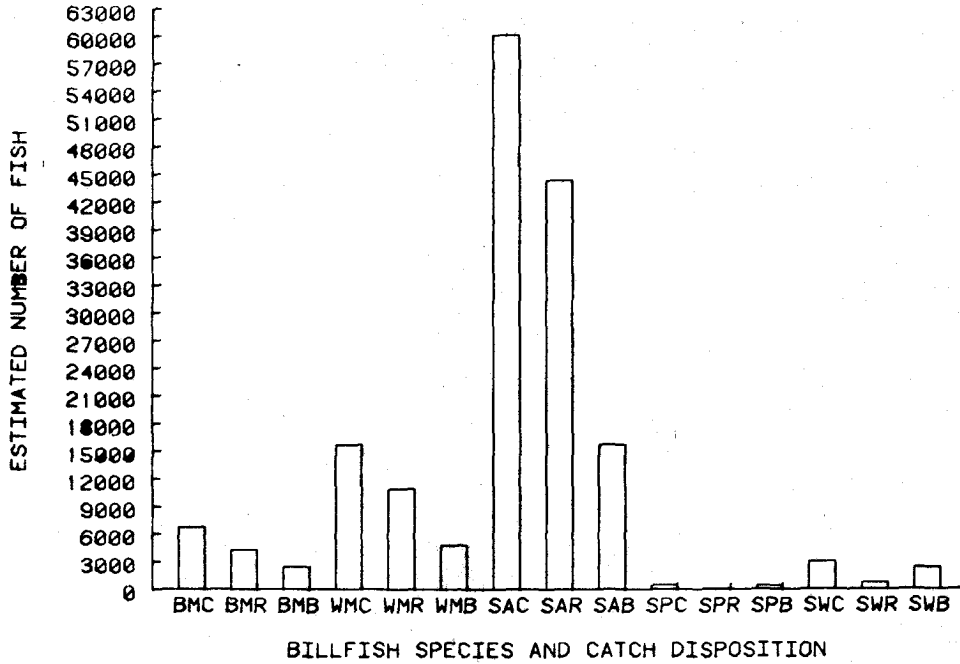
Figure 16

PERCENT OF THE ESTIMATED CATCH OF EACH BILLFISH SPECIES THAT WERE RELEASED AND BOATED (KILLED)
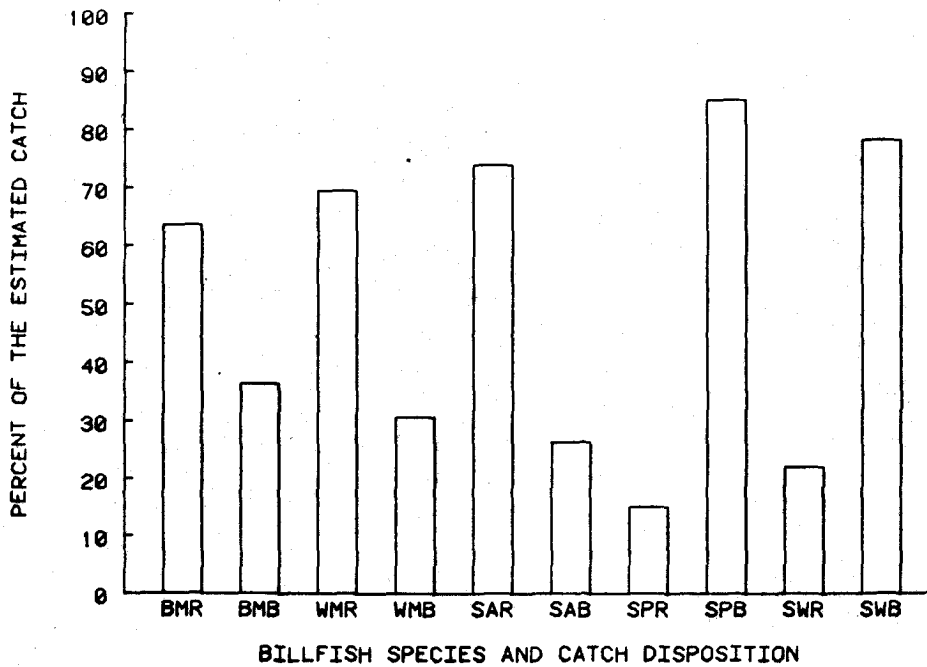
Table 4 summarized the catch statistics by area for each billfish species. The data on the number of fish caught were taken from area totals provided in Appendix II. Percentages of the total catch for each species, and totals, were calculated by dividing the number caught in a specific area by the total number caught in all areas. Figures 17 through 22 plot Table 4 statistics column by column.

Table 4

Estimated Number and Percent of Total Catch for Each Billfish Species in Each Area Surveyed

Area Fished	Number of Blue Marlin Caught	Percent of Total Blue Marlin Catch	Number of White Marlin Caught	Percent of Total White Marlin Catch	Number of Sailfish Caught	Percent of Total Sailfish Catch	Number of Spearfish Caught	Percent of Total Spearfish Catch	Number of Swordfish Caught	Percent of Total Swordfish Catch	Number of Billfish Caught	Percent of Total Billfish Catch
Virginia and Northward	1024	15.2	5387	34.4	1213	2.0	20	4.3	1065	35.5	8709	10.1
North Carolina to Florida	1183	17.5	3891	24.9	4271	7.1	12	2.6	54	1.8	9411	11.0
Florida East Coast and Keys	1244	18.4	1398	8.9	47419	79.0	194	41.5	1052	35.1	51307	60.0
Gulf of Mexico	1233	18.3	3615	23.1	5051	8.4	231	49.5	702	23.4	10832	12.6
Puerto Rico and U.S. Virgin Islands	1077	16.0	111	.7	173	.3	10	2.1	73	2.4	1444	1.7
Other Waters	984	14.6	1248	8.0	1880	3.1	*	*	54	1.8	4166	4.9
Total[1]	6745	100.0	15650	100.0	60007	99.9	467	100.0	3000	100.0	85869	100.3

[1] Totals may differ by rounding error
* No catch reported

Figure 17 plots the estimated number and percent of blue marlin caught during the study period in each of the areas defined in this survey. This graph shows that the catch of blue marlin seems to be fairly equally distributed among the six areas, varying less than 4%.

Figure 18 plots the estimated number and percent of white marlin caught in the six areas during the study period. It shows a decrease in catch going south along the Atlantic coast and then an increase in the Gulf of Mexico. Note that almost 60% of the total catch is from north of Florida.

Figure 17

ESTIMATED NUMBER AND PERCENT OF BLUE MARLIN CAUGHT BY AREA
(TOTAL NUMBER CAUGHT = 6,745)
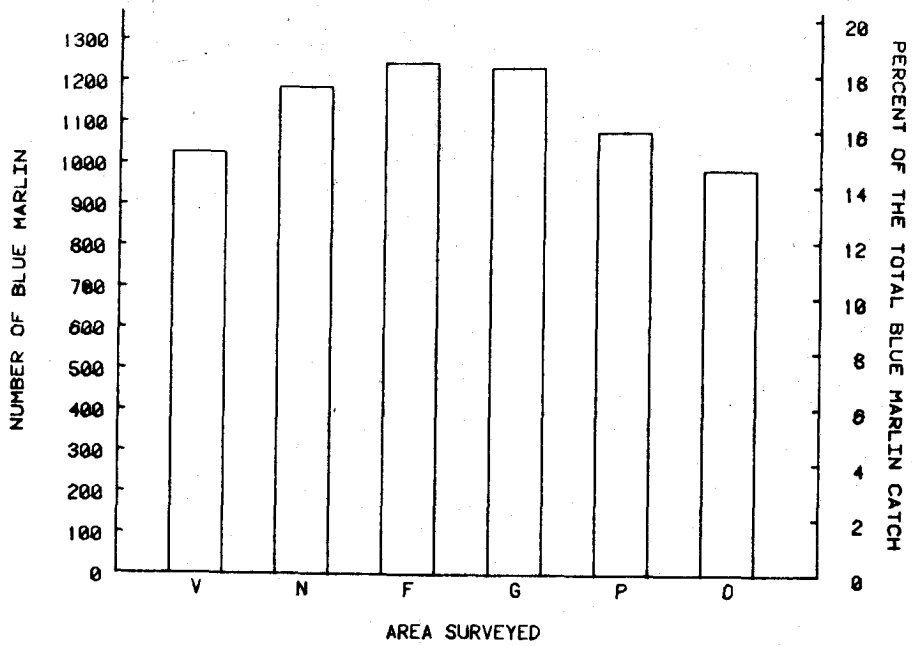
Figure 18

ESTIMATED NUMBER AND PERCENT OF WHITE MARLIN CAUGHT BY AREA
(TOTAL NUMBER CAUGHT = 15,650)
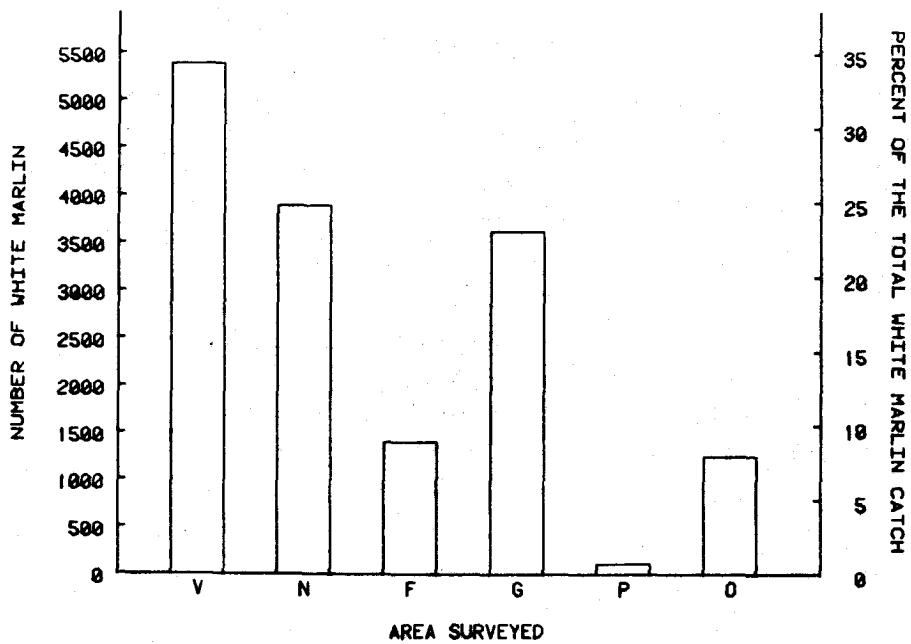
Figure 19 plots the estimated number and percent of sailfish caught during the survey period for the survey areas defined. Note that almost 80% of the catch comes from the Florida East Coast and Florida Keys, which are known to be productive sailfish areas.

Figure 20 plots the estimated number and percent of spearfish caught by area. It is known that, historically, this species is indeed very rare in the recreational catch, and these data agree with that fact. Even though the actual number of reported fish was small, the data may be reliable enough to show a trend for most spearfish to be caught from Florida to the Gulf of Mexico (over 90% in this survey). This species is believed to be rather tropical in its distribution, and fishing effort is shown later in this report to be high in these two areas. These two factors may well explain and therefore reinforce the trend shown by these data, regardless of the actual numbers reported.

Figure 19

ESTIMATED NUMBER AND PERCENT OF SAILFISH CAUGHT BY AREA
(TOTAL NUMBER CAUGHT = 60,008)
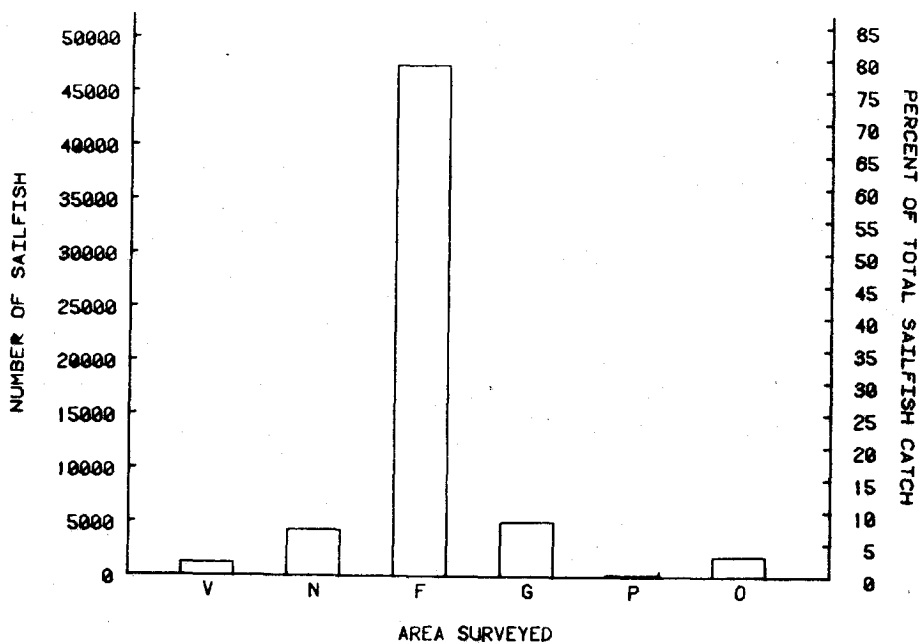
Figure 20

ESTIMATED NUMBER AND PERCENT OF SPEARFISH CAUGHT BY AREA
(TOTAL NUMBER CAUGHT = 467)
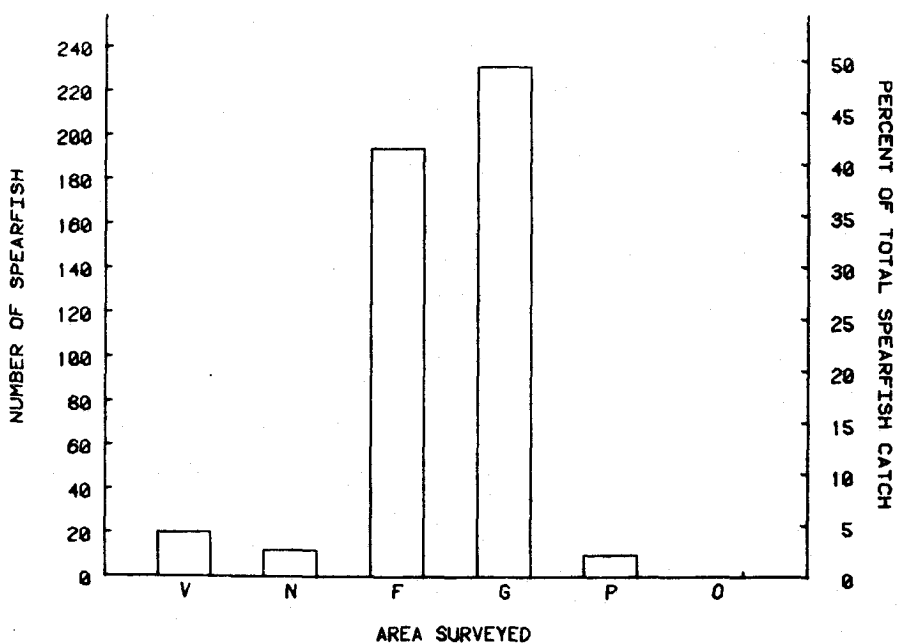
Figure 21 plots the estimated number and percent of swordfish caught for the areas surveyed. The distribution of catch demonstrates that the active recreational fisheries for this species tend to be north of Virginia, along the Florida East Coast, and in the Gulf of Mexico. Catch in these areas combined comprised 94% of the total catch of swordfish.

Figure 22 plots the estimated number and percent of billfish (including all five species surveyed) caught in each area. Of the total billfish catch, 60% comes from the Florida East Coast and Keys; however, over 90% of this catch is sailfish.

Figure 21

ESTIMATED NUMBER AND PERCENT OF SWORDFISH CAUGHT BY AREA
(TOTAL NUMBER CAUGHT = 3000)
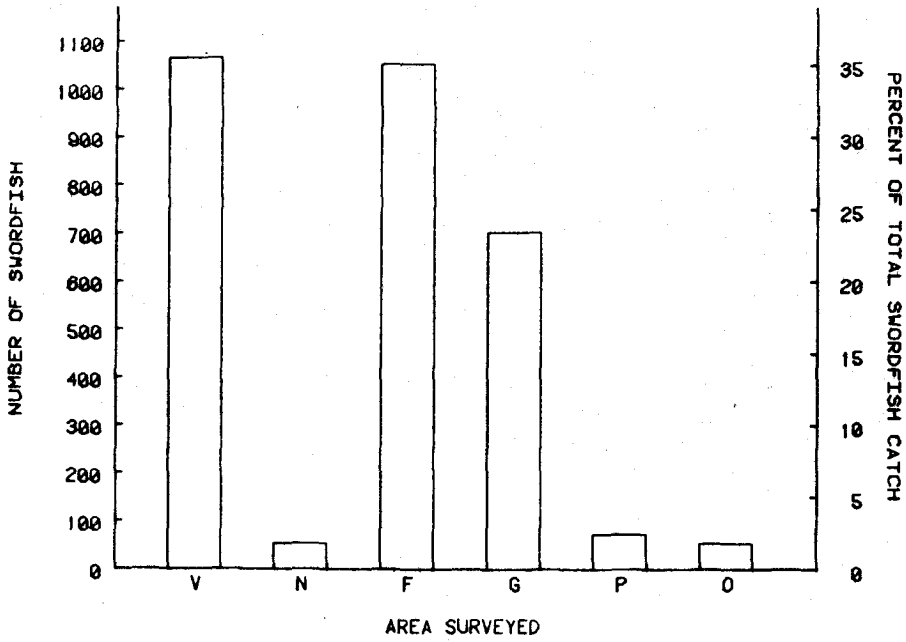
Figure 22

ESTIMATED TOTAL NUMBER AND PERCENT OF BILLFISH CAUGHT BY AREA
(TOTAL NUMBER CAUGHT = 85,869)
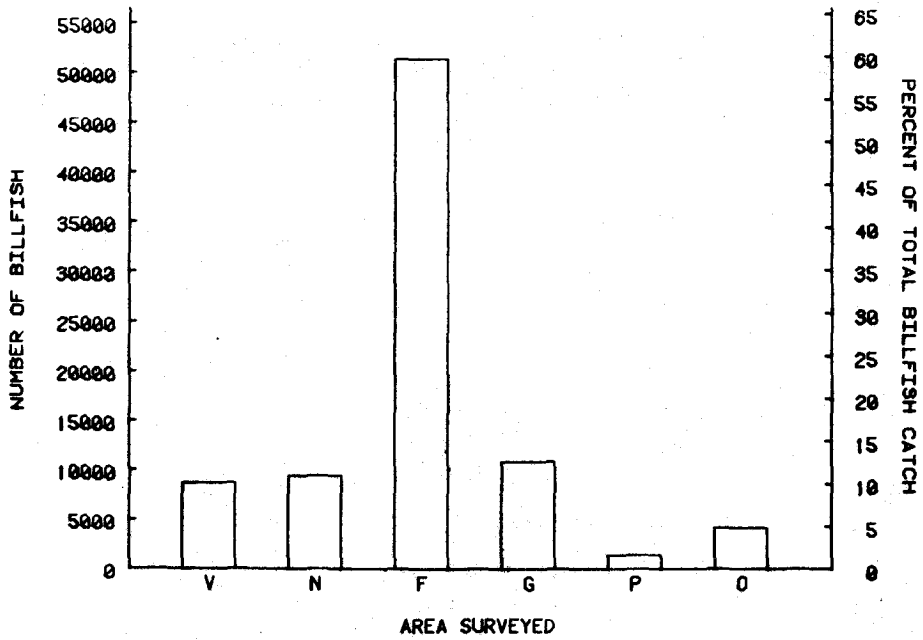
Table 5 contains billfish catch estimates summarized from Appendix II by boat size class. These numbers were produced by summing for all areas the estimated catch of a species by boat size class. For instance, to obtain the estimated catch of white marlin by boat size class 2 (20-25 foot boats), the catch for this species and size class were added for areas V + N + F + G + P + O. The standard error for these estimates can be obtained by using the same procedure of summing on the variances reported for each point estimate and finding the square root of the total. The row of data labeled DE/PR in Table 6 reports the combined catch for boats registered in Delaware and Puerto Rico, where boat size data could not be used in sample selection. The columns of data in Table 5 are graphed in histograms in Figures 23 through 28.

Table 5

Estimated Catch by Species by Boat Size Class

Boat Size in Feet	Number of Blue Marlin Caught	Percent of Total Blue Marlin Catch	Number of White Marlin Caught	Percent of Total White Marlin Catch	Number of Sailfish Caught	Percent of Total Sailfish Catch	Number of Spearfish Caught	Percent of Total Spearfish Catch	Number of Swordfish Caught	Percent of Total Swordfish Catch	Number of Billfish Caught	Percent of Total Billfish Catch
18-19	345	5.1	297	1.9	5877	9.8	36	7.7	302	10.1	6857	8.0
20-25	1792	26.6	3931	25.1	24409	40.7	273	58.5	880	29.3	31285	36.4
26-34	2057	30.5	3479	22.2	9312	15.5	148	31.7	1337	44.6	16333	19.0
35-45	1465	21.7	7297	46.6	17571	29.2	*	*	318	10.6	26651	31.0
46-65	837	12.4	174	1.1	2540	4.2	*	*	54	1.8	3605	4.2
DE/PR	250	3.7	470	3.0	300	.5	10	2.1	110	3.7	1140	1.3
Total[1]	6746	100.0	15648	99.9	60009	99.9	467	100.0	3001	100.1	85871	99.9

[1] Totals may differ by rounding error
* No catch reported

Figure 23 plots the estimated number and percent of blue marlin caught by each

boat size class during the study period. Boats from 20 to 45 feet long

account for almost 80% of the total estimated catch of blue marlin.

Figure 24 plots the estimated number and percent of white marlin caught by

each boat size class during the study period. The large number of whites

caught by 35-45 foot boats may be influenced by the spatial distributions of

this species. Referring to Figures 17 and 18, we see that the blue marlin

catch was well distributed, whereas 60% of the white marlin catch was from

north of Florida. Boats from 20 to 45 feet catch almost 94% of the total

catch of white marlin. Combining blue and white marlin catches, we see that

boats 20-45 feets are responsible for almost 90% of the recreational catch of

Atlantic marlin.

Figure 23

ESTIMATED NUMBER AND PERCENT OF BLUE MARLIN CAUGHT BY BOAT SIZE CLASS
(TOTAL NUMBER CAUGHT = 6,745)

BOAT SIZE CLASS IN FEET (AND DELAWARE/PUERTO RICO)
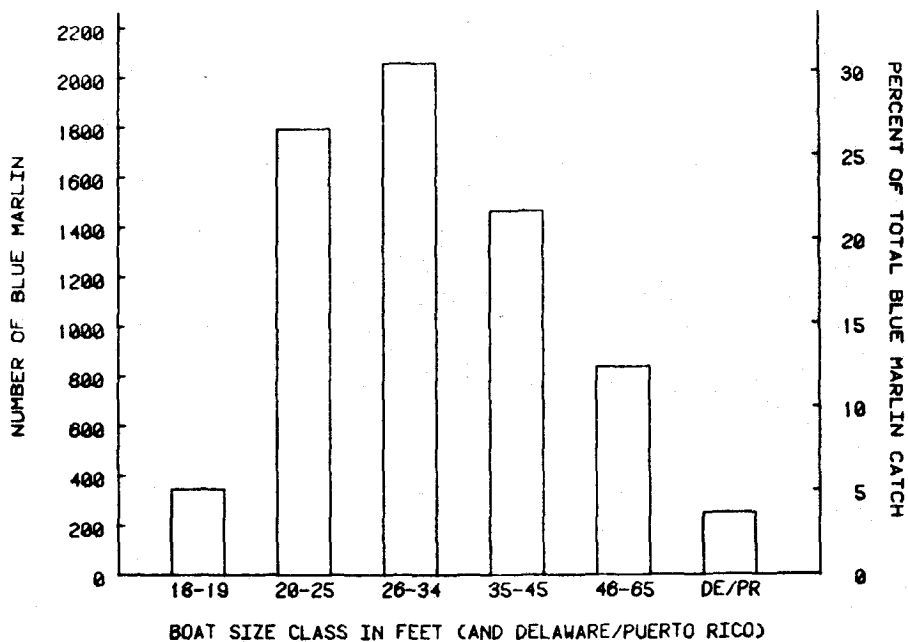
Figure 24

ESTIMATED NUMBER AND PERCENT OF WHITE MARLIN CAUGHT BY BOAT SIZE CLASS
(TOTAL NUMBER CAUGHT = 15,648)

BOAT SIZE CLASS IN FEET (AND DELAWARE/PUERTO RICO)
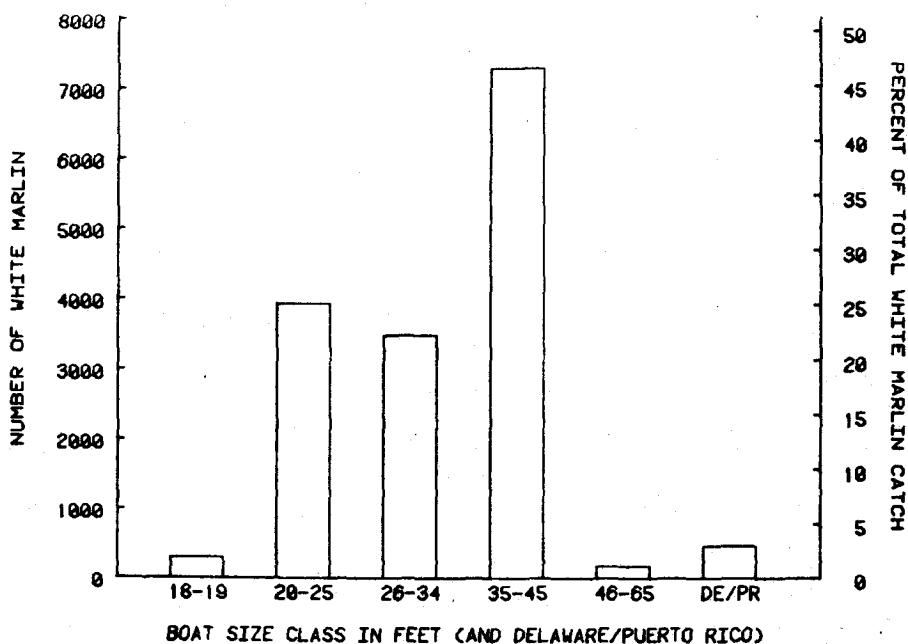
Figure 25 plots the estimated number and percent of sailfish caught by boat size class. The catch for 26-34 foot boats seems low considering there are many more boats of this size than 35-45 foot boats. This may be explained by the higher average number of days fished by 35-45 foot boats shown in Figure 39 and their greater average success as shown in Figure 41. Two boat classes, 20-25 feet and 35-45 feet, catch almost 70% of the estimated catch of sailfish.

Figure 26 plots the estimated number and percent of spearfish caught by boat size class. It appears that 20-34 foot boats catch approximately 90% of the fish, but this may be an anomaly.

Figure 25

ESTIMATED NUMBER AND PERCENT OF SAILFISH CAUGHT BY BOAT SIZE CLASS
(TOTAL NUMBER CAUGHT = 60,009)

BOAT SIZE CLASS IN FEET (AND DELAWARE/PUERTO RICO)
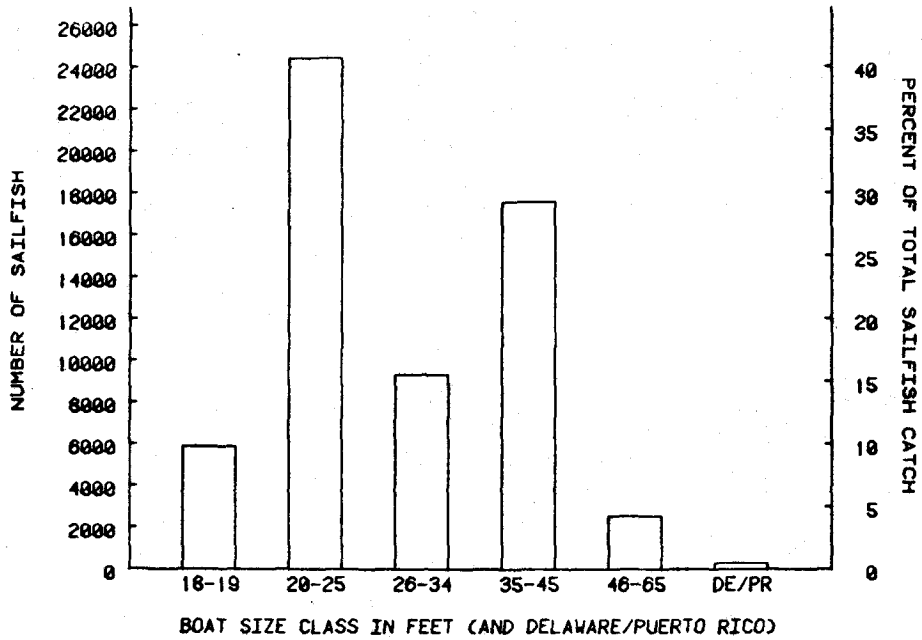
Figure 26

ESTIMATED NUMBER AND PERCENT OF SPEARFISH CAUGHT BY BOAT SIZE CLASS
(TOTAL NUMBER CAUGHT = 467)

BOAT SIZE CLASS IN FEET (AND DELAWARE/PUERTO RICO)
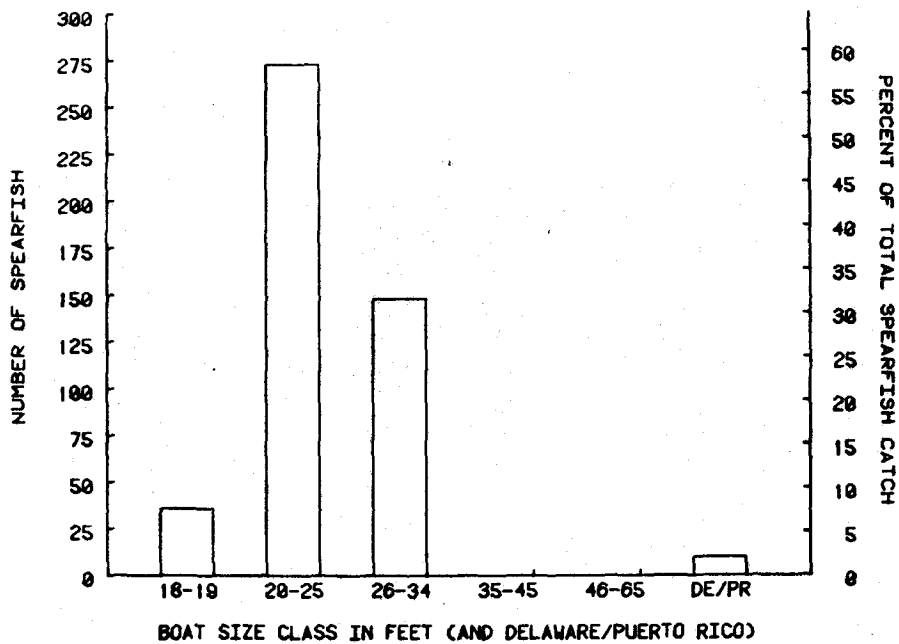
Figure 27 plots the estimated number and percent of swordfish caught by boat size class. Catch increases with boat size for the first three size classes, and then sharply decreases. The decrease is probably a result of the fewer number of larger boats in the population. About 74% of the total catch is by boats between 20 and 34 feet.

Figure 28 plots the estimated number and percent of billfish, all species combined, caught by boat size class. The relatively low values for 26-34 foot boats are primarily a result of the influence of the sailfish and white marlin catches. Over 86% of the total catch of billfish is from boats between 20 to 45 feet.

Figure 27

ESTIMATED NUMBER AND PERCENT OF SWORDFISH CAUGHT BY BOAT SIZE CLASS
(TOTAL NUMBER CAUGHT = 3,001)

BOAT SIZE CLASS IN FEET (AND DELAWARE/PUERTO RICO)
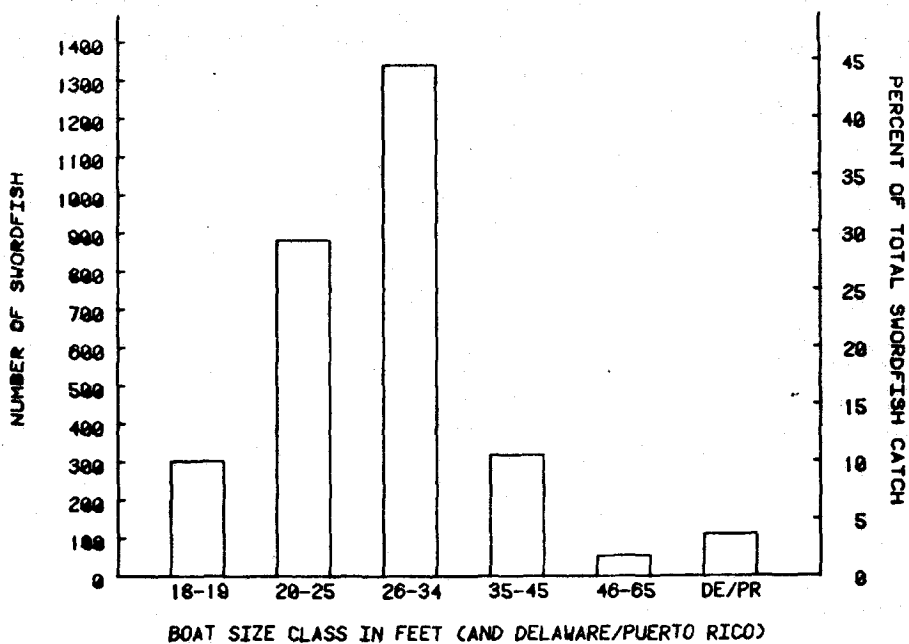
Figure 28

ESTIMATED NUMBER AND PERCENT OF BILLFISH CAUGHT BY BOAT SIZE CLASS
(TOTAL NUMBER CAUGHT = 85,871)

BOAT SIZE CLASS IN FEET (AND DELAWARE/PUERTO RICO)
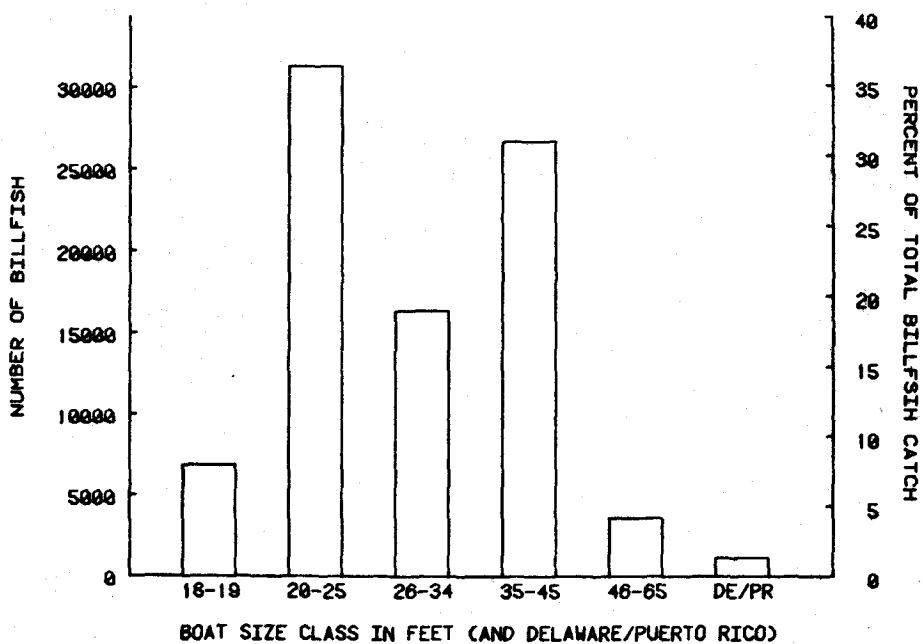
Table 6 reports the species composition of billfish by area. The data on the estimated number caught for each species in each area were taken directly from area totals reported in Appendix II. The percent data reported were calculated by dividing the number of fish caught by the total number of billfish caught for that area times 100. The resultant data are percent of billfish species composition for each species in each area. The columns of data in Table 6 are plotted in Figures 29 through 34.

Table 6

Billfish Species Composition by Area

	Virginia and Northward		North Carolina to Florida		Florida East Coast and Keys		Gulf of Mexico		Puerto Rico and U.S. Virgin Islands		Other Waters		Total Billfish Catch Species Composition	
	Number Caught	Percent of Total Catch	Number Caught	Percent of Total Catch	Number Caught	Percent of Total Catch	Number Caught	Percent of Total Catch	Number Caught	Percent of Total Catch	Number Caught	Percent of Total Catch	Number Caught	Percent of Total Catch
Blue Marlin	1024	11.8	1183	12.6	1244	2.4	1233	11.4	1077	74.6	984	23.6	6745	7.9
White Marlin	5387	61.9	3891	41.3	1398	2.7	3615	33.4	111	7.7	1248	30.0	15650	18.2
Sailfish	1213	13.9	4271	45.4	47419	92.4	5051	46.6	173	12.0	1880	45.1	60007	70.0
Spearfish	20	.2	12	.1	194	.4	231	2.1	10	.7	*	*	467	.5
Swordfish	1065	12.2	54	.6	1052	2.1	702	6.5	73	5.1	54	1.3	3000	3.5
Total[1]	8709	100.0	9411	100.0	51307	100.0	10832	100.0	1444	100.1	4166	100.0	85869	100.1

[1] Totals may differ by rounding error
* No catch reported

Figure 29 plots the estimated number and percent of each species of billfish
caught by recreational boats fishing in waters off Virginia and northward.
The most abundant species appears to be white marlin, with over four times the
catch of any other species. White marlin comprise almost 62% of the total
billfish catch for this area.

Figure 30 plots the estimated number and percent of each species of billfish
caught by recreational boats from North Carolina to the Florida border. These
data indicate that blue and white marlin are still relatively abundant, and
that sailfish appear to be caught more frequently than farther north. Since
sailfish are somewhat tropical in distribution, it is reasonable to see an
increase in catch in this area. Almost 87% of the total billfish catch in
this area is comprised of white marlin and sailfish.

Figure 29

ESTIMATED NUMBER AND PERCENT OF EACH BILLFISH SPECIES
CAUGHT VIRGINIA AND NORTHWARD
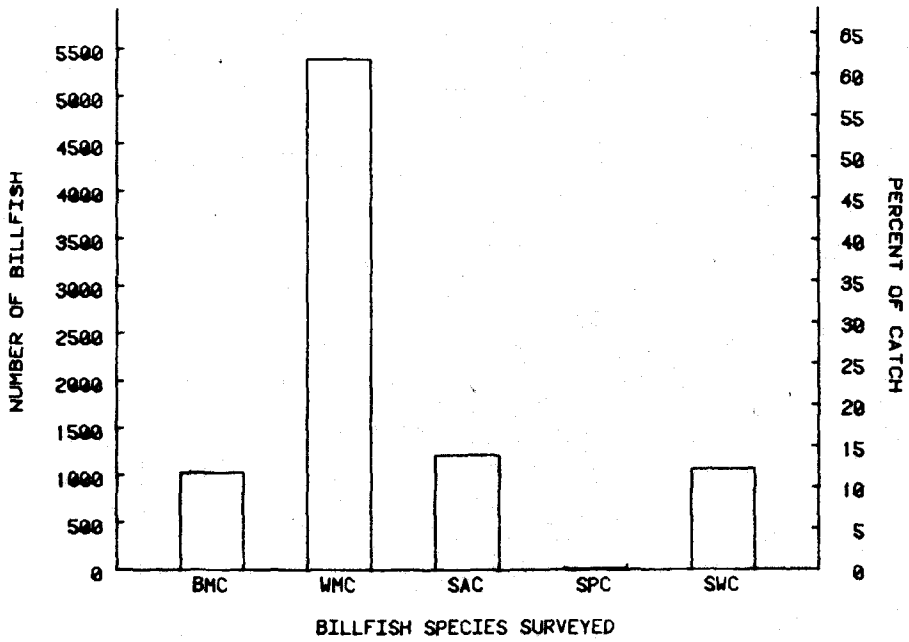
Figure 30

ESTIMATED NUMBER AND PERCENT OF EACH BILLFISH SPECIES
CAUGHT FROM NORTH CAROLINA TO FLORIDA
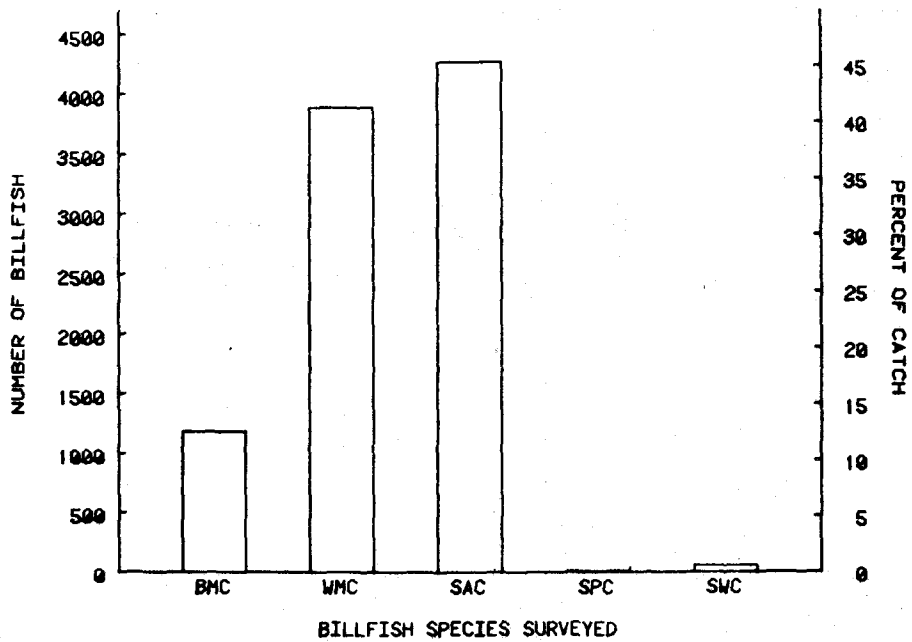
Figure 31 plots the estimated number and percent of each billfish species caught from recreational boats off the Florida East Coast and Florida Keys. As seen in other graphs, sailfish are the most abundant billfish in this area, virtually dwarfing the other billfish species in number caught. Sailfish comprise over 92% of the total billfish catch for this area.

Figure 32 plots the estimated number and percent of each species of billfish caught in the Gulf of Mexico by recreational boats. These data seem to reinforce historical data on the relative abundance of the five billfish species in this area. Three species -- blue marlin, white marlin, and sailfish -- comprise over 91% of the total billfish catch for the Gulf of Mexico.

Figure 31

ESTIMATED NUMBER AND PERCENT OF EACH BILLFISH SPECIES
CAUGHT OFF THE FLORIDA EAST COAST AND KEYS
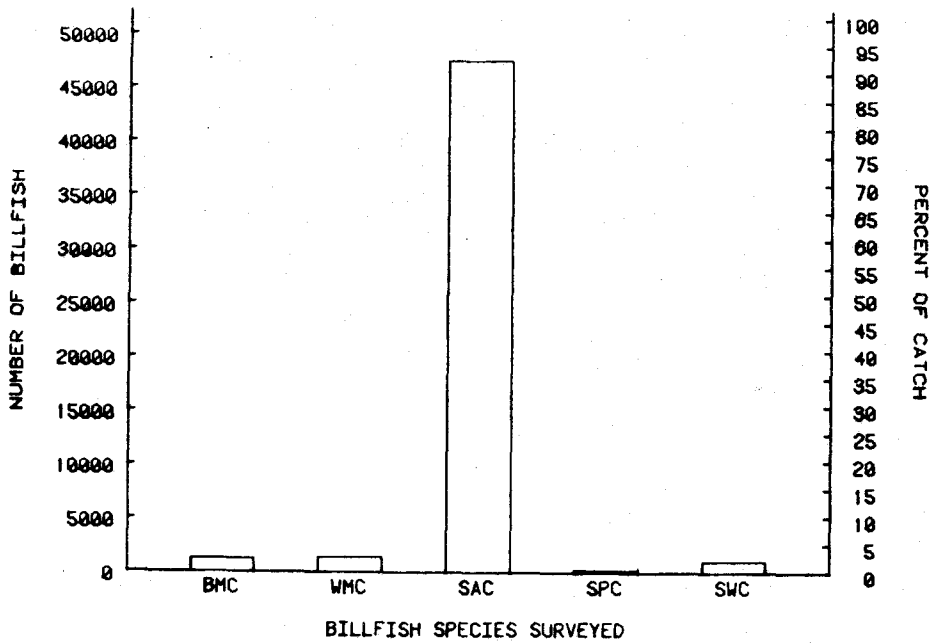
Figure 32

ESTIMATED NUMBER AND PERCENT OF EACH BILLFISH SPECIES
CAUGHT IN THE GULF OF MEXICO
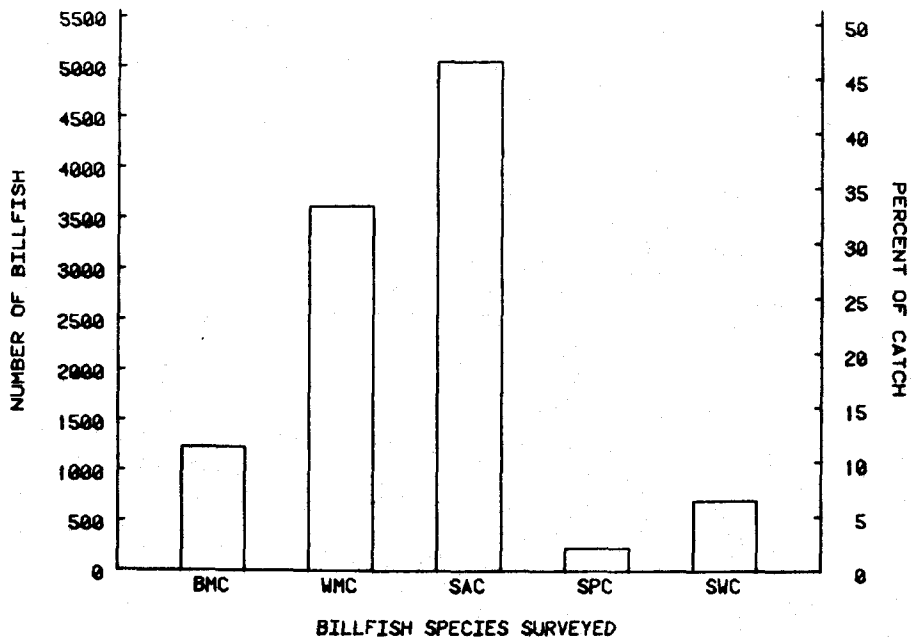
Figure 33 plots the estimated number and percent of each species of billfish caught from recreational boats in waters around Puerto Rico and the U.S. Virgin Islands. Cursory examination of the raw, unexpanded response data showed that only about half of the catch reported in this area was from boats registered in Puerto Rico or the U.S. Virgin Islands. These data show that blue marlin comprise 75% of the total billfish catch for this area.

Figure 34 plots the estimated number and percent of each billfish species caught from recreational boats in the western North Atlantic Ocean and not included in any of the other study areas. Based on examination of comments written on the actual survey forms returned, the majority of the catch for this area is believed to come from Bahamian waters. Almost 99% of the catch is comprised of blue marlin, white marlin and sailfish, with sailfish making up over 45% of the total billfish catch.

Figure 33

ESTIMATED NUMBER AND PERCENT OF EACH BILLFISH SPECIES CAUGHT OFF PUERTO RICO AND U.S. VIRGIN ISLANDS
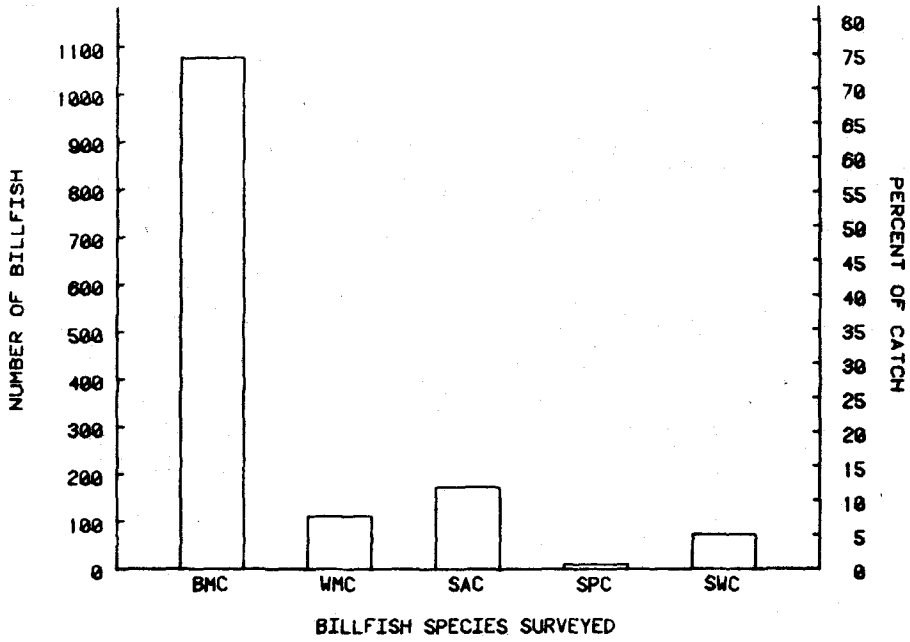
Figure 34

ESTIMATED NUMBER AND PERCENT OF EACH BILLFISH SPECIES CAUGHT IN OTHER WATERS
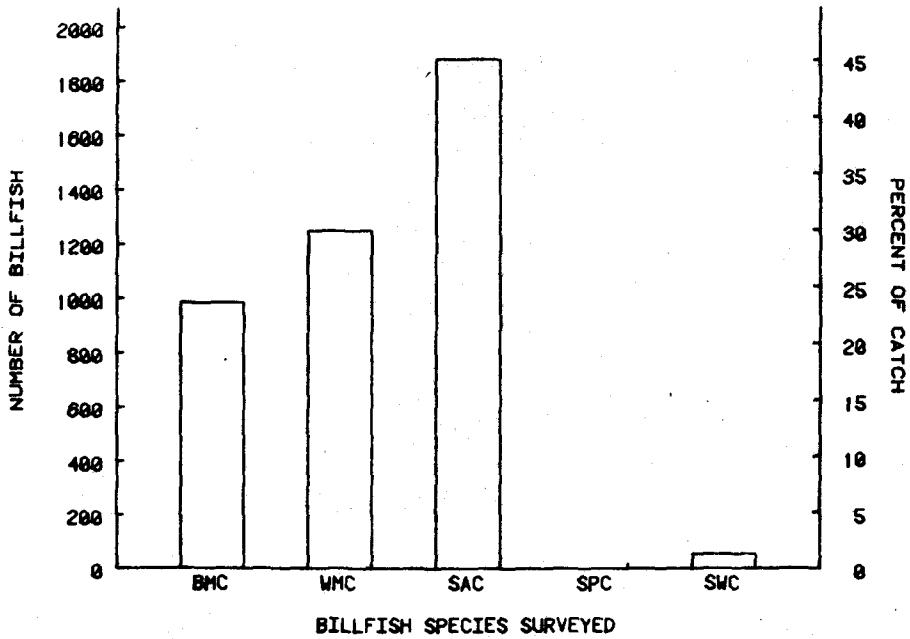
Billfish Effort Data Analyses

This survey was designed to collect data on days fished for billfish and sharks by area (Figure 3). If the number of days fished for billfish is reported by a respondent, the catch-per-unit effort can be calculated for the individual by dividing the number of billfish caught (all species combined) by the number of days fished. By combining the results of all respondents in a group to be analyzed (i.e., by size class and area), an average catch-per-unit effort can be calculated for the group. By combining results of respondents within identifiable groups, it is also possible to calculate the average number of days fished per boat, the average number of fish caught per boat, and the average number of days fished per fish caught. Combining these analyses with other data we have on the population and estimated catch, and making further calculations, it is possible to obtain estimates of parameters such as number of boats in a fishery and total effort for a fishery.

One principal problem with these estimates is that not all respondents who fished reported the number of days they fished. This means that estimates of effort parameters can be based only on those individuals who reported days fished. The assumption that must be made, therefore, is that the response of these people is representative of the population. Because only those people reporting days fished can be used in effort analysis, the actual number of respondents upon which estimates must be based is reduced. Out of 2,408 respondents who fished, 314 did not report days fished, and are, therefore, unusable for effort data analysis.

Another factor that must be considered is how to handle those boats fishing in more than one area: included in the 2,408 responses, are 2,007 who fished one area, 159 who fished two areas, 21 who fished three areas, and 5

who fished·for areas, giving a total of 2,192 boats represented by the 2,408 responses. Therefore, if we treat each boat in each area as an exclusive event and use proportions and percentages of total response to make estimates, it becomes immaterial how many boats are actually represented by the total number of responses. That is, of the 2,408 fishing events (a boat fishing in an area) reported, 314 did not report days fished, and are therefore undefinable as to whether they were fishing for billfish or sharks. Of the remaining 2,094 responses, 960 reported fishing for only billfish, 451 reported fishing for both billfish and sharks, and 683 reported fishing for only sharks. This means that 67.4% of the identifiable respondents fished for billfish (((960 + 451) / (2408 - 314)) X 100 = 67.4%), and 54.2% fished for sharks (((683 + 451) / (2408 - 314)) X 100 = 54.2%). The overlap of 21.6% is from those fishing for both billfish and sharks.

Estimating the number of boats fishing for billfish can be done in several ways, all of which make assumptions about the data used. Only the most straightforward method will be discussed in this report. The first two methods utilize the total response information (i.e., percent of a stratum who said they fished (Appendix I)), the population size of the stratum (Appendix I), and the percent of those reporting who fished for billfish (67.4% as calculated previously). By multiplying the percent who fished in a stratum times the number of boats in the stratum times the estimated 67.4% of billfishermen, it is possible to calculate the estimated number of boats in the population. Using this method on a state-by-state basis, an estimate of 17,392 billfishing boats is obtained (Table 7). However, this assumes that all size classes and states do the same amount of billfishing. A better estimate may be obtained by combining all boats of a given size class and calculating a new percentage of billfishermen for that size class. By using

Table 7

Estimated Number of Boats in the Billfish/Shark
Fishery and the Billfish Fishery

State File	Estimated Number Boats In Billfish/Shark Fishery	Estimated Number Boats In Billfish Fishery
Alabama	647	436
Coast Guard	3157	2128
Connecticut	524	353
Delaware	691	466
Florida East	6085	4101
Florida Gulf	1570	1058
Georgia	259	175
Louisiana	1115	752
Massachusetts	618	417
Maryland	453	305
Mississippi	281	189
North Carolina	1023	690
New Hampshire	20	13
New Jersey	1787	1204
New York	3284	2213
Puerto Rico	478	322
Rhode Island	223	150
South Carolina	568	383
Texas	2155	1452
Virginia	771	520
Virgin Islands	96	65
TOTALS	25805	17392

combined size class data as the basis for expansion, the only assumption made
is that the variability of fishing effort between states is properly weighted
by the percent who fished per stratum calculation (refer to Appendix I).
Therefore, by summing for all states all the estimated number of boats fishing
for billfish or sharks in a boat size class, and multiplying the result times
a newly calculated percent of those who fished for that size class, an
estimate of the number of billfishing boats for that size class can be
obtained. Summing the resultant size estimates for all size classes, an
estimate of the total number of billfishing boats can be obtained. Table 8
provides the data used in making size class estimates of number of boats
fishing for billfish. The results of Delaware and Puerto Rico must again be
handled separately because of lack of boat size data for these files.

The next method for estimating the number of boats in the billfish
fishery utilizes the estimated billfish catch by boat size class (Appendix II)
and an estimate of the number of billfish caught per boat for each size class.
Calculations of average number of billfish caught per boat by size class used
in this method are based on the data of those who reported days fished
information. Table 9 summarized the data of estimated billfish catch by boat
size class (from Appendix II) and response data of those reporting days
fished. The assumptions made using this method are that those reporting days
fished information are representative of the total population, and that the
point estimates of catch are accurate. Figures 35 and 36 plot the average
catch per boat and estimated number of boats in the billfish fishery. This
method would be used if there was reason to believe that the average catch
information by boat size class was the most reliable data available.

Table 8

Estimates of Billfishing Boats Based on Size Class Response Data

Boat Size in Feet	Estimated Number of Boats in Billfish/Shark Fishery	Number Responses Reporting Days Fished for Billfish	Number Responses Reporting Days Fished For Billfish or Sharks	Percent Billfishing	Estimated Number of Boats Fishing for Billfish
18-19	2538	82	108	75.9	1926
20-25	13528	464	730	63.6	8604
26-34	5547	564	874	64.5	3578
35-45	2430	243	303	80.2	1949
46-65	590	23	27	85.2	503
Delaware	478	24	38	63.2	437
Puerto Rico	691	11	14	78.6	376
Totals	25802	1411	2094	67.4	17373

Table 9

Estimates of the Number of Boats in the Billfish Fishery Based on Average Catch Statistics
by Boat Size Class

Boat Size in Feet	Estimated Number of Billfish Caught (Appendix II)	Number of Reporting Days Fished for Billfish	Number of Billfish Caught	Average Number of Billfish Caught Per Boat	Estimated Number of Boats in the Billfish Fishery
18-19	6857	82	375	4.57	1500
20-25	31285	464	1233	2.66	11761
26-34	16333	564	1962	3.48	4693
34-45	26651	243	2042	8.40	3173
46-65	3605	23	165	7.17	503
DE/PR	1140	35	114	3.26	350
Totals	85871	1411	5891	4.18	21980

Figure 35 plots the average number of billfish caught per boat by size class based on the response data of those reporting days fished. It appears that 35-45 foot boats catch more billfish per boat than any other size class.

Figure 36 plots the estimated number of boats in the billfish fishery by boat size class. These estimates were based on the average catch of the respondents who reported days fished. By dividing the estimated number of billfish caught from boats in a given boat size class (Appendix II) by the average number of billfish caught per boat for each size class, an estimate of the number of boats in the billfish fishery can be obtained.

Figure 35

AVERAGE NUMBER OF BILLFISH CAUGHT PER BOAT BY BOAT SIZE CLASS
(BASED ON THOSE REPORTING DAYS FISHED)

BOAT SIZE CLASS IN FEET (AND DELAWARE/PUERTO RICO AND AVERAGE)
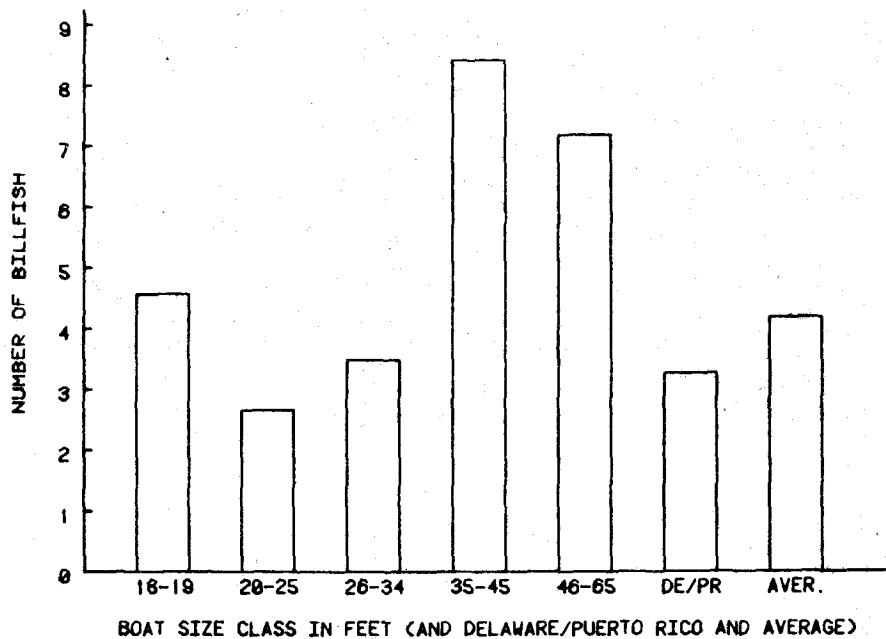
Figure 36

ESTIMATED NUMBER OF BOATS IN THE BILLFISH FISHERY BY BOAT SIZE CLASS
BASED ON AVERAGE CATCH OF THOSE REPORTING DAYS FISHED

BOAT SIZE CLASS IN FEET (AND DELAWARE/PUERTO RICO)
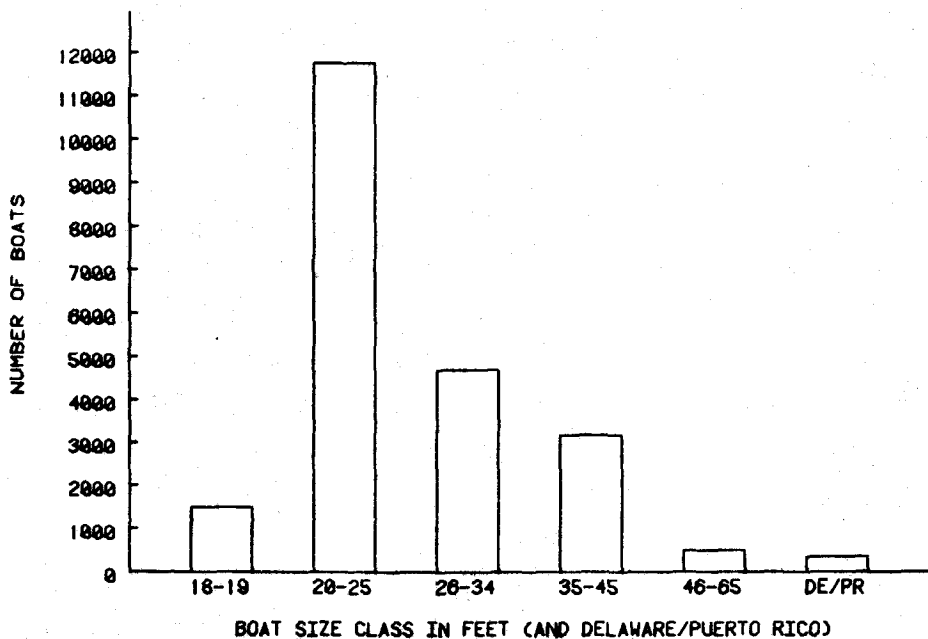
The final method for estimating the number of boats in the billfish fishery, which will be discussed in this report, uses average catch data by area. This method would be useful if it was believed that area data summaries were the most reliable data upon which calculation should be based. The assumptions made with this method are the same as the last method. Table 10 and Figures 37 and 38 summarize the data used by this method to estimate the number of boats in the billfish fishery.

Table 10

Estimates of the Number of Boats in the Billfish Fishery Based on Average Catch Statistics by Fishing Area.

Area Fished	Estimated Number of Billfish Caught (Appendix II)	Number Reporting Days Fished for Billfish	Total Number of Billfish Caught	Average Number of Billfish Caught per Boat	Estimated Number of Boats in the Billfish Fishery
Virginia and Northward	8709	337	722	2.14	4070
North Carolina to Florida	9411	185	600	3.24	2905
Florida East Coast and Keys	51307	500	3082	6.16	8329
Gulf of Mexico	10832	282	908	3.22	3364
Puerto Rico and U.S. Virgin Islands	1444	27	126	4.67	309
Other Waters	4166	80	438	5.48	760
Totals	85869	1411	5876	4.16	19737

Figure 37 plots the average number of billfish caught per boat by area fished, based on the respondents who reported days fished. Boats fishing off the Florida East Coast and Keys, where sailfish catch is very high, appear to have the largest average number of fish caught per boat. North Carolina to Florida and the Gulf of Mexico appear to have about the same average catch per boat.

Figure 38 plots the estimated number of boats in the billfish fishery by area based on the catch of respondents reporting days fished and the total estimated catch for each area from Appendix II. The number of boats was estimated by dividing the estimated number of billfish caught in each area by the average number of billfish caught per boat.

Figure 37
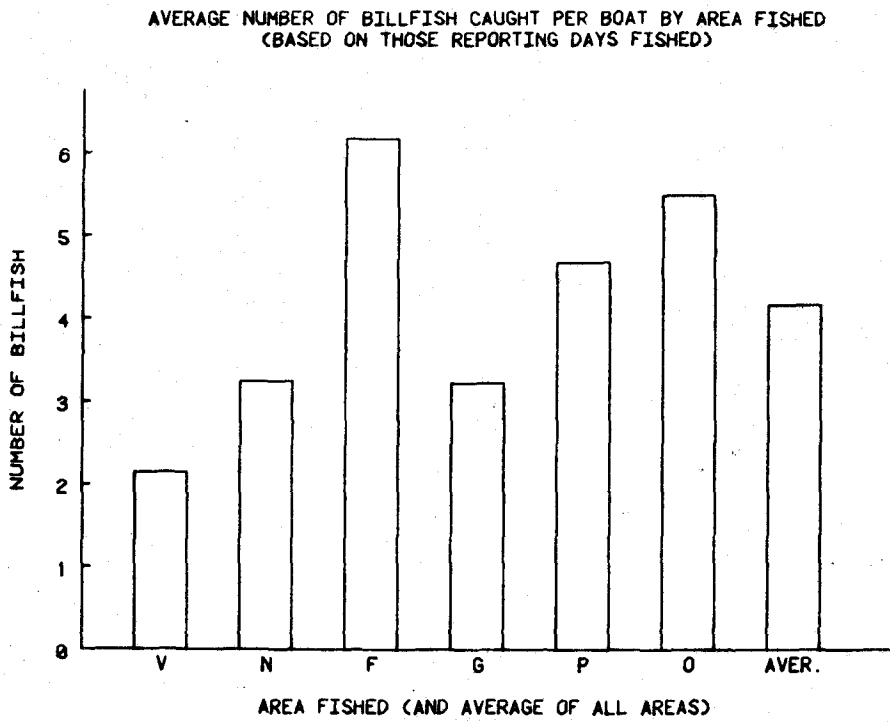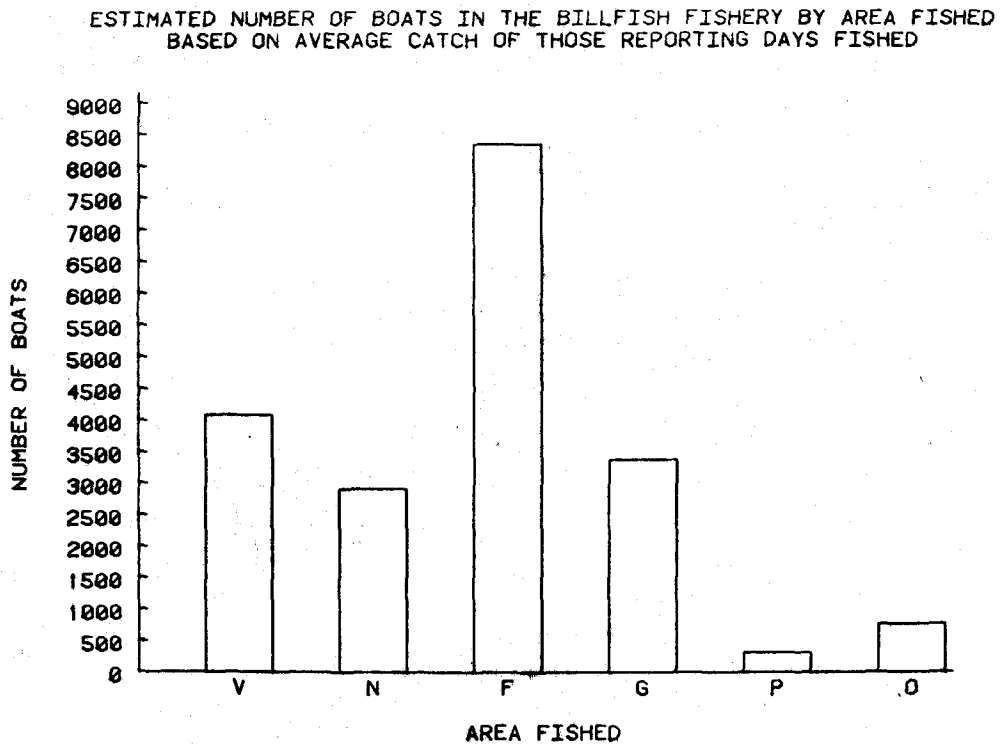
AVERAGE NUMBER OF BILLFISH CAUGHT PER BOAT BY AREA FISHED
(BASED ON THOSE REPORTING DAYS FISHED)

Figure 38

ESTIMATED NUMBER OF BOATS IN THE BILLFISH FISHERY BY AREA FISHED
BASED ON AVERAGE CATCH OF THOSE REPORTING DAYS FISHED

Other effort data analyses include calculations of the average number of days fished per boat, the average number of days fished per billfish caught, average number of billfish caught per day fished, and estimates of the total number of days fished in the fishery. Calculations can be made based on boat size or area fished, as in the methods already described. In all analyses of effort data, only respondents reporting days fished can be used. Table 11 and Figures 39 to 42 present effort data by boat size class. The estimates for total number of days fished by size class were calculated by multiplying the average number of days fished per boat times the estimated number of boats per size class (Table 8).

Table 12 and Figures 43 to 46 report summarized data by area. The totals for estimated number of days fished by area were calculated by multiplying the average number of days fished per boat times the estimated number of boats fishing each area (Table 10).

The average number of billfish caught per day fished seems to be reasonably constant whether the data are examined by boat size class (Table 11) or by area (Table 12). In both cases, the overall average number of billfish caught per day fished is 0.29. This can be used with the total estimated number of billfish caught data (Appendix II) to calculate the estimated number of days fished in the recreational billfish fishery. By dividing the total estimated number of billfish caught (85,869) by the average number of billfish caught per day (0.29) a total estimate of 296,100 days fished is obtained. This estimate is very close to the estimate in Table 12, which was calculated by the method described above.

Table 11

Estimates of Effort Spent Fishing for Billfish by Boat Size Class

Boat Size in Feet	Number of Reporting Days Fished For Billfish	Number of Billfish Caught	Number of Days Fished	Average Number of Days Fished per Boat	Average Number of Days Fished per Billfish Caught	Average Number Billfish Caught per Day Fished	Total Estimated Number of Days Fished
18-19	82	375	1442	17.6	3.8	.26	33898
20-25	464	1233	5772	12.4	4.7	.21	106690
26-34	564	1962	7344	13.0	3.7	.27	46514
35-45	243	2042	4909	20.2	2.4	.42	39370
46-65	23	165	322	14.0	2.0	.51	7042
Delaware	24	58	303	12.6	5.2	.19	5506
Puerto Rico	11	41	255	23.2	6.2	.16	8723
Totals	1411	5876	20347	14.4	3.5	.29	247743

Figure 39 plots the average number of days fished per boat by boat size class, based on respondents reporting days fished information. The results of Delaware and Puerto Rico are plotted separately, as is the average of all size classes combined. These data seem to show a somewhat greater average number of days fished for 35-45 foot boats than for other size classes.

Figure 40 plots the average number of days fished per billfish caught by boat size class based on the data for respondents reporting days fished information. It is interesting to note the decrease in number of days fished as boat size increases (excluding 18-19 foot boats that fish primarily in the most productive areas, the Florida East Coast). This seems to show an increase in the success rate of larger boats.

Figure 39

AVERAGE NUMBER OF DAYS FISHED FOR BILLFISH PER BOAT BY BOAT SIZE CLASS
(BASED ON THOSE REPORTING DAYS FISHED)

BOAT SIZE IN FEET (AND DELAWARE, PUERTO RICO, AND AVERAGE)
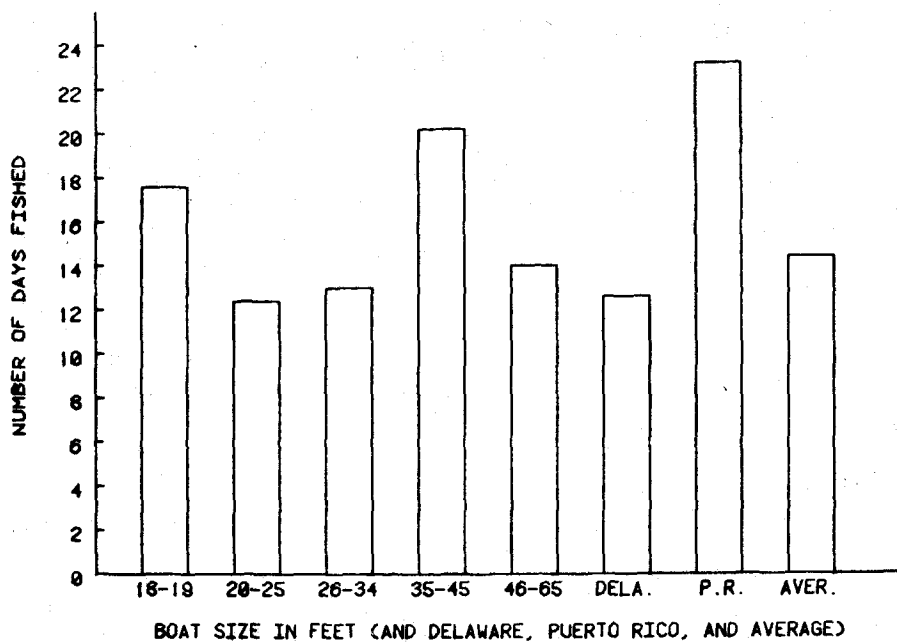
Figure 40

AVERAGE NUMBER OF DAYS FISHED PER BILLFISH CAUGHT BY BOAT SIZE CLASS
(BASED ON THOSE REPORTING DAYS FISHED)

BOAT SIZE IN FEET (AND DELAWARE, PUERTO RICO, AND AVERAGE)
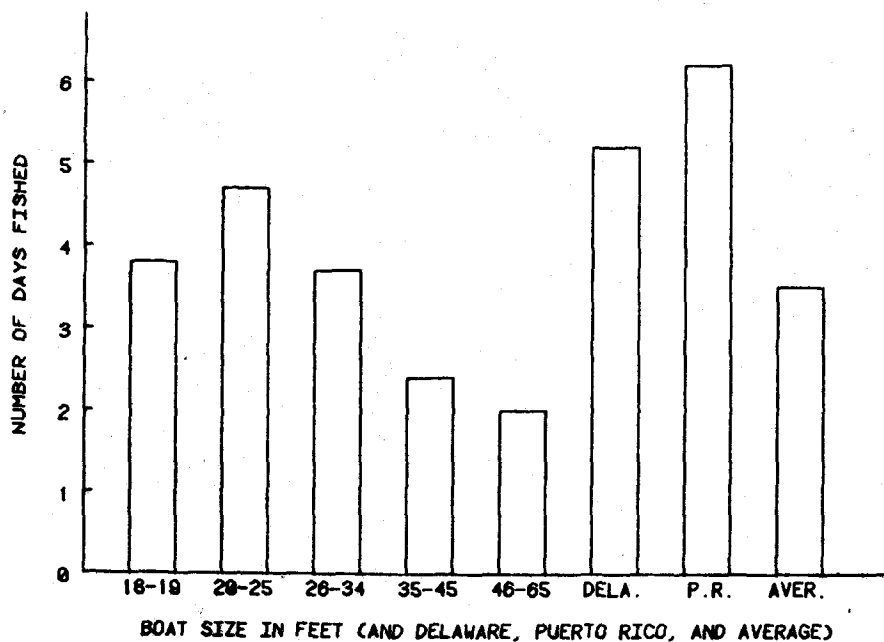
Figure 41 plots the average number of billfish caught per day fished by boat size class based on data of respondents reporting days fished information. This measurement of catch-per-unit of effort (number of fish per day) was calculated by dividing the total number of fish caught for each size class by the total number of days reported fished for that size class. The data seem to indicate increasing success rate with increasing boat size.

Figure 42 plots the estimated number of days fished for billfish by each boat size class. The apparent decrease in fishing effort with increase in boat size (18-19 foot boats excluded) is probably a result of the decrease in number of boats registered in the larger size classes. The total effort of 35-45 foot boats is much closer to the effort of 26-34 foot boats than would be expected considering how many fewer 35-45 foot boats there are in the population (Figure 6). This is related to the apparently higher level of effort (Figure 39) for the larger size boats.

Figure 41

AVERAGE NUMBER OF BILLFISH CAUGHT PER DAY FISHED BY BOAT SIZE CLASS
(BASED ON THOSE REPORTING DAYS FISHED)
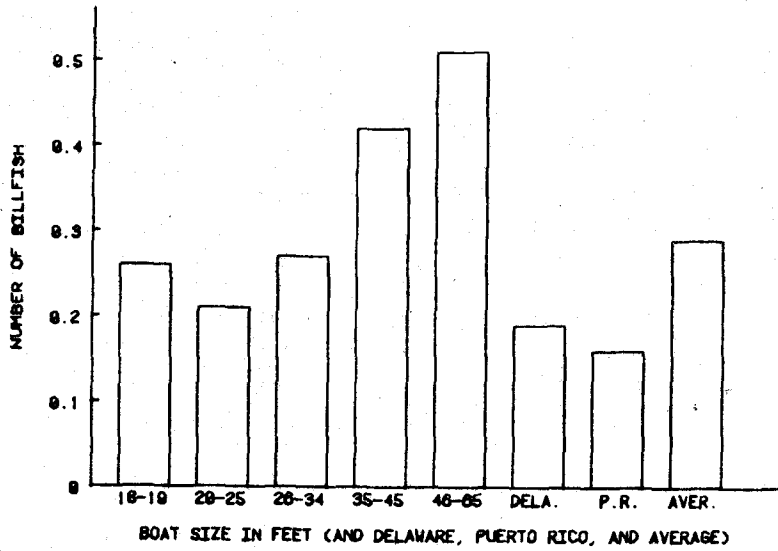
Figure 42

ESTIMATED TOTAL NUMBER OF DAYS SPENT BILLFISHING BY BOAT SIZE CLASS
(BASED ON THOSE REPORTING DAYS FISHED)
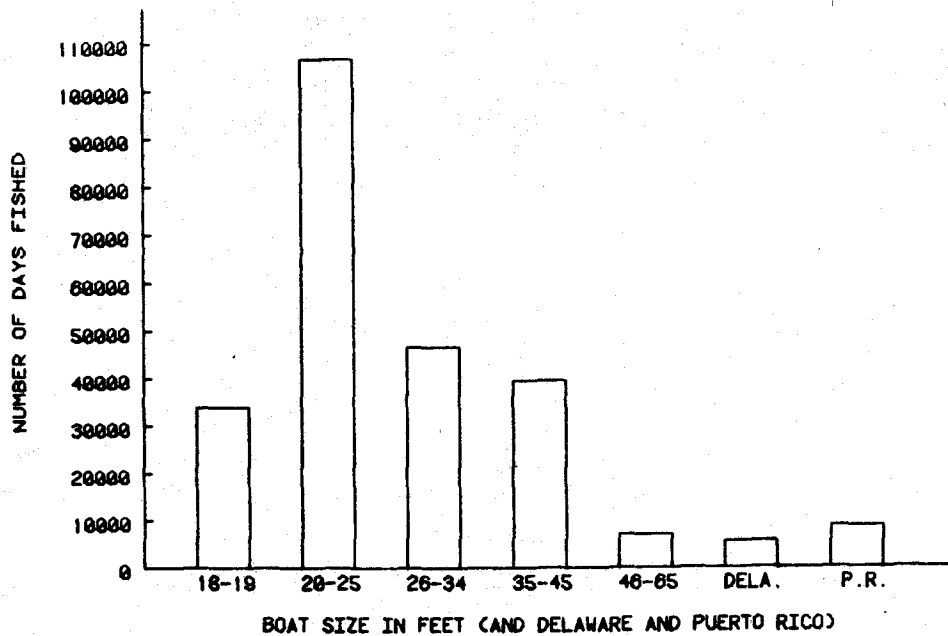
Table 12

Estimates of Effort Spent Fishing for Billfish by Area Fished

Area Fished	Number of Reporting Days Fished For Billfish	Number of Billfish Caught	Number of Days Fished	Average Number of Days Fished per Boat	Average Number of Days Fished per Billfish Caught	Average Number Billfish Caught per Day Fished	Total Estimated Number of Days Fished
Virginia and Northward	337	722	3022	9.0	4.2	.24	36630
North Carolina to Florida	185	600	2077	11.2	3.5	.29	32536
Florida East Coast and Keys	500	3082	10543	21.1	3.4	.29	175742
Gulf of Mexico	282	908	3405	12.1	3.8	.27	40704
Puerto Rico and U.S. Virgin Islands	27	126	449	16.6	3.6	.28	5129
Other Waters	80	438	851	10.6	1.9	.51	8056
Totals	1411	5876	20347	14.4	3.5	.29	298797

Figure 43 plots the average number of days fished for billfish per boat by

area fished, based on the data of respondents who reported days fished

information. The outstanding feature of this graph is the relatively high

level of effort off the Florida East Coast and Keys.

Figure 44 plots the average number of days fished per billfish caught by area

fished based on data of respondents reporting days fished information. The

success rate of billfishing is basically the same for all areas, with the

exception of "Other Waters."

Figure 43

AVERAGE NUMBER OF DAYS FISHED FOR BILLFISH PER BOAT BY AREA FISHED
(BASED ON THOSE REPORTING DAYS FISHED)

AREA FISHED (AND AVERAGE OF ALL AREAS)
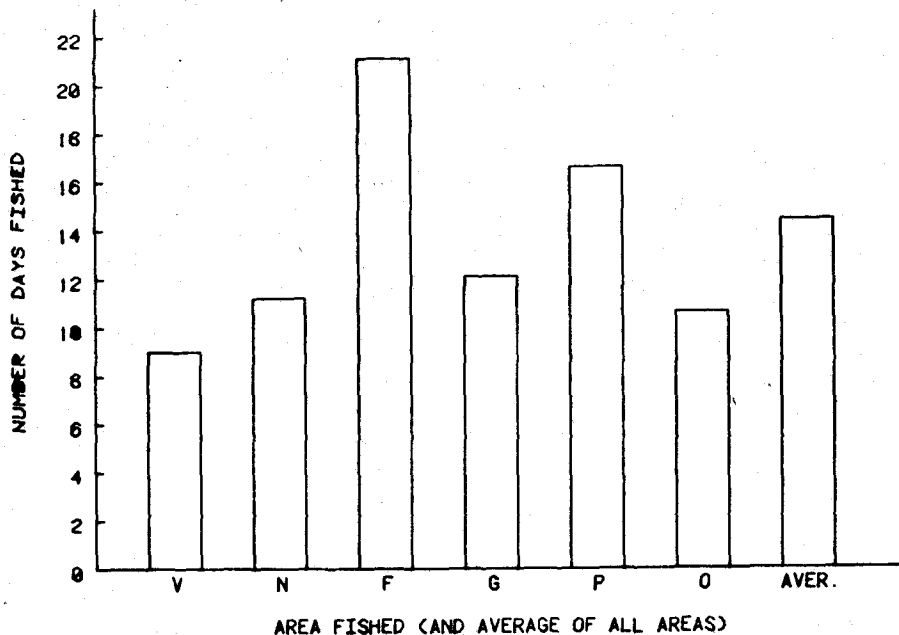
Figure 44

AVERAGE NUMBER OF DAYS FISHED PER BILLFISH CAUGHT BY AREA FISHED
(BASED ON THOSE REPORTING DAYS FISHED)

AREA FISHED (AND AVERAGE OF ALL AREAS)
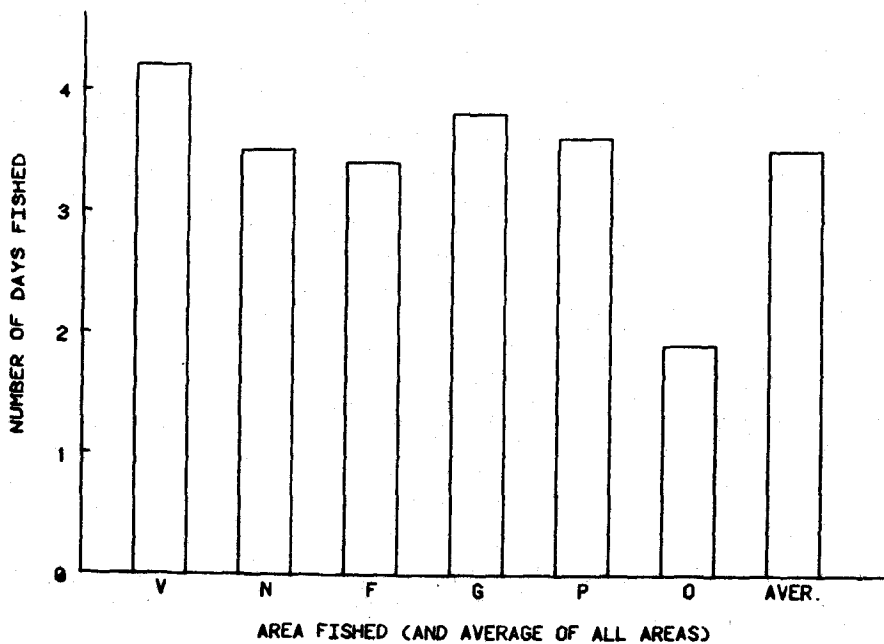
Figure 45 plots the average number of billfish caught per days fished by area based on data of respondents reporting days fished information. This shows essentially the same success rate for all areas except in "Other Waters." The majority of fishing done in "Other Waters" by U.S. registered boats is probably done during peak billfish season, because reaching these waters requires a special trip outside American waters. This trip is more likely to be made when the fisherman has a good chance of catching a fish, hence the high success rate for this area.

Figure 46 plots the estimated number of days spent billfishing by area based on the catch data of respondents reporting days fished and the estimated number of boats in the billfish fishery in each area (Table 10). The level of effort for the Florida East Coast and Keys appears to be high compared to other areas. Comparing this to the estimated total catch of billfish by area (Figure 22), we see the graphs are almost identical. We would expect a good correlation between total catch and total effort by area since Figure 45 shows relatively equal success rates for all areas.

Figure 45

AVERAGE NUMBER OF BILLFISH CAUGHT PER DAY FISHED BY AREA FISHED
(BASED ON THOSE REPORTING DAYS FISHED)
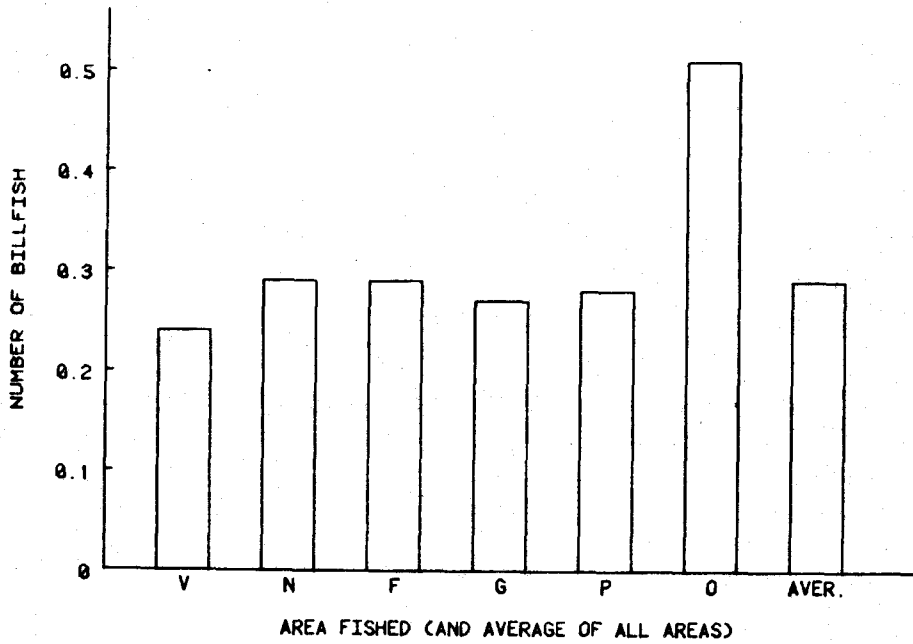
Figure 46

ESTIMATED NUMBER AND PERCENT OF DAYS SPENT BILLFISHING BY AREA
(BASED ON THOSE REPORTING DAYS FISHED)
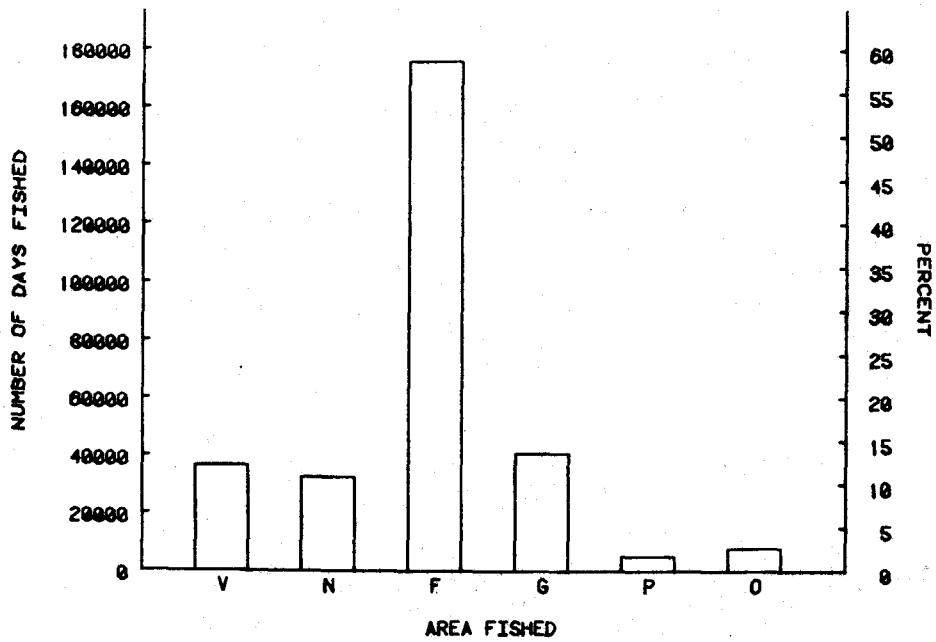
Other Billfish Analyses

Data presented thus far have dealt with expansion data and effort data analyses. The recreational billfish survey also collected data on whether or not boats were primarily used for charter, and if any of the fish were caught in tournaments. It is possible to analyze charter versus noncharter and tournament versus nontournament catches in relation to almost every application of the data already discussed; however, to analyze these data on too fine a detail may be stretching application of the data beyond advisable statistical limits. It is useful, however, to examine some of the overall statistics of these two groups of data.

Table 13 contains some statistics on the charter boat versus noncharter boat recreational catch of all billfish species combined. Data are reported for total number of responses and for respondents who reported days fished information. The "Number of Fishing Events" in Table 13 refers to a boat fishing in an area, regardless of whether it also fished another area. The 186 fishing events recorded by charter boat respondents represented 177 boats. Of the reporting charter boats, 4.5% fished in more than one area. The data appears to point out that charter boats generally fish more days and catch more fish in less time than noncharter boats. Billfish species composition was approximately the same for both charter and noncharter boats. Out of all the respondents who reported days fished information, 8.5% were charter boats; however, the number of days fished by these boats was 18.7% of the total number of days fished, and their catch was 31.2% of the total catch reported by respondents who recorded days fished data. These data reemphasize the apparent fact that charter boats generally have much better success at billfishing than do noncharter boats.

Table 13

Charter Boat Versus Noncharter Boat Statistics

	Number of Fishing Events	Days Fished	Number of Billfish Caught	Average Number of Billfish Caught Per Boat	Average Number of Days Fished per Boat	Average Number of Days Fished per Billfish Caught	Average Number of Billfish Caught per Day Fished
Charter Boats Reporting Days Fished for Billfish	120	3806	1831	15.3	31.7	2.1	.48
Noncharter Boats Reporting Days Fished for Billfish	1291	16541	4045	3.1	12.8	4.1	.24
All Charter Boats	186	?	2324	12.5	?	?	?
All Noncharter Boats	2222	?	5007	2.3	?	?	?

? Not Applicable

Of the 7,331 billfish reported in this survey, 865 (11.8%) were reported caught in a tournament. These tournament fish were reported by 218 boats who's total billfish catch during the study period was 3,280. This means that only 26.4% of the fish they caught were reported in tournaments, and that their total catch was 44.7% of the reported catch of billfish during the study period. Assuming these statistics hold true for the entire population, about 45% of the recreational catch of billfish is caught by about 15% of the total number of boats fishing for billfish. The average number of days fished per billfish caught was 1.8 for boats entering fish in tournaments. Average number of billfish caught per day fished by these boats was 0.55, whereas the overall average for all boats was only 0.29. The average number of billfish caught per boat by tournament boats was 15 fish as compared to 3.3 fish by all boats. Billfish species composition of the catch of tournament boats was basically the same as nontournament boats.

Some of these statistics concerning charter and tournament boats are dramatic, but are probably very realistic when one considers the nature of the billfish fishery. People operating either charter boats or tournament boats are specialists. They are, on the average, more dedicated to sport fishing and specifically billfishing than are the majority of weekend boaters. Good success at billfishing requires a certain level of expertise and special equipment and preparation coupled with good luck. Most people operating charter boats or tournament boats have the expertise, equipment, and make the preparations; most other fishermen rely more heavily on good luck, quite often with little success. If another billfish survey is required in the future, these statistics of charter and tournament catch may prove very helpful in its design.

Shark Expansion Data Analyses

It was believed that data on the recreational shark fishery could be collected during the billfish survey but it was recognized that the target population for the billfish survey was not exactly the same as the target population would be for a shark survey. Therefore, data on catch of sharks collected during the billfish survey do not represent estimates of total recreational catch because there remains an unsurveyed portion of the total shark fishing population, i.e., small boat and pier shark fishermen.

The questionnaire requested data on the number of sharks caught, number released, and the number of days fished by areas. It also requested information on tournament catch and species identification for overall catch. All expansion data analyses and effort data analyses were based on all shark species combined. Analyses of species composition were based on actual respondent data, not expanded population estimates as was the case for billfish. Data for analyses using population estimates were taken from Appendix II.

The percent of sharks released in each area appears to be more varied than might possibly be expected. However, the standard errors associated with these data must be considered when examining results. Table 14 presents estimates, including 95% confidence intervals, for the number of sharks caught, released, and boated by area fished. Figure 47 plots shark catch data by area and Figure 48 plots shark catch data by boat size class from Table 15.

Table 14

Estimated Shark Catch Statistics by Area Fished

Area Fished	Number Caught	95% CI		Number Released	95% CI		Number Boated	95% CI		Percent of Catch Released
Virginia and Northward	124,226	83,964 –	164,488	99,520	61,946 –	137,094	24,705	19,129 –	30,281	80.1
North Carolina to Florida	16,296	8,246 –	24,346	13,684	5,732 –	21,636	2,613	1,581 –	3,645	84.0
Florida East Coast & Keys	40,184	28,098 –	52,270	19,796	12,076 –	27,516	20,388	12,002 –	28,774	49.3
Gulf of Mexico	46,405	36,047 –	56,763	28,309	19,715 –	36,903	18,096	13,648 –	22,544	61.0
Puerto Rico and U.S. Virgin Islands	776	136 –	1,416	423	125 –	971	353	107 –	599	54.5
Other Waters	2,536	1,504 –	3,568	1,905	999 –	2,811	631	285 –	977	75.1
Totals	230,423	186,373 –	274,473	163,637	123,517 –	203,757	66,786	55,720 –	77,852	71.0

Table 15

Estimated Number of Sharks

Caught by Boat Size Class

Boat Size In Feet	Estimated Number Caught	Percent of Total Catch
18-19	16,418	7.1
20-25	103,667	45.0
26-34	85,994	37.3
35-45	19,378	8.4
46-65	1,945	.8
DE/PR	3,020	1.3
TOTAL	230,422	

Proper identification of most sharks is difficult even for experienced fishermen. The questionnaire requested that the respondent write in the number of sharks caught for each species identified. This introduces several potential sources of respondent error. First and foremost is the problem of proper identification. Because the possible number of shark species caught in the recreational fishery is very large, it was not practical to send a list of shark names with every questionnaire. Second, most people combine certain species into groups, i.e., hammerheads, makos, sand sharks, etc. Additionally, the common names used to identify sharks vary among areas. The reader is cautioned to remember these facts while reading this section, as the term "species" will be loosely used to represent the groups identified by respondents. There is probably also a tendency toward "identification" of the

Figure 47 plots the estimated number of sharks caught in each of the study areas by recreational boats. It is well known that the recreational shark fishery from Virginia and northward is very active. These data show that over half of the entire estimated catch of sharks (by number) come from this area.

Figure 48 plots the relationship between boat size and estimated number of sharks caught. These data show that over 80% of the estimated recreational catch of sharks was made from boats from 20 to 34 feet.

Figure 47

ESTIMATED NUMBER AND PERCENT OF SHARKS CAUGHT IN EACH AREA
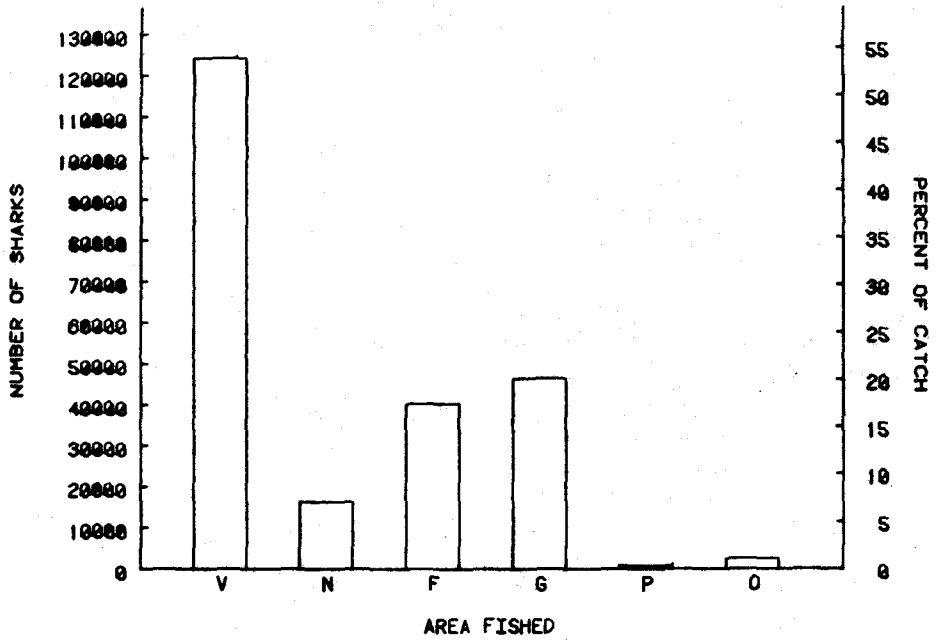
Figure 48

ESTIMATED NUMBER AND PERCENT OF SHARKS CAUGHT
BY BOAT SIZE CLASS
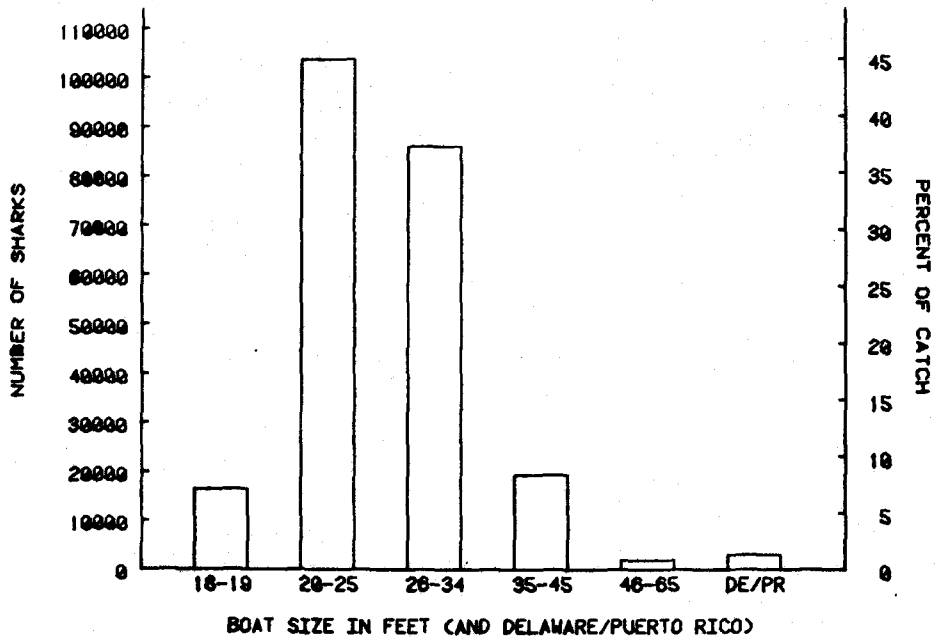
most recognized and sought after sharks, i.e., whites, makos, etc. Another problem encountered in this survey was that many people identified sharks, but did not enter the number caught for each species. In these cases, the response was edited to record one caught for every shark identified. Respondent memory bias may also play a larger role in all aspects of the reliability of shark data than in the billfish data, because catching a shark is not as rare an event and therefore not as memorable as catching a billfish. Consequently, the following analyses of shark species composition are presented with the realization that they may only give possible indications of the nature of the shark catch.

There were 28 "species" of sharks identified by respondents. Each species was assigned a 2-digit code for the purpose of data entry and analysis. For ease of reporting, a 1-digit code is used in the following graphs of percent species composition. These codes are provided in Table 16. Data on shark species composition reflects actual respondent information which has not been weighted according to strata characteristics and expanded to represent the population.

Shark identification data were collected irrespective of area fished. However, the catch by respondents who fished in only one area can be associated with the area in which they fished. By eliminating data for all individuals who fished in more than one area, it is possible to build a subset of shark data. Estimates of total shark species composition can be based on all sharks identified, not just the ones identified by respondents who fished in only one area. All shark species composition data by area are summarized in Table 17 and plotted in Figures 49 through 55.

Table 16

Billfish Survey Shark Species Codes Used in
Data Entry, Analysis, and Data Presentation

Entry Code	Species	Plotting Code	Entry Code	Species	Plotting Code
01	Basking	A	23	Night	O
02	Blackfin	B	24	Nurse	P
04	Blacktip	C	26	Porbeagle	Q
06	Blue	D	28	Sand	R
08	Brown	E	30	Sandbar	S
10	Bull	F	31	Sand Tiger	T
11	Dog	G	32	Shovelnose	U
12	Dusky	H	33	Sharpnose	V
14	Finetooth	I	34	Silky	W
16	Gray	J	36	Spinner	X
18	Hammerhead	K	37	White	Y
19	Leopard	L	38	Thresher	Z
20	Lemon	M	39	Whitetip	1
22	Mako	N	40	Tiger	2

Areas "F" and "G" each had over 100 respondents who identified sharks and area "V" had over 300. Species composition for these three areas are less likely to be biased because of low number of responses. The other three areas had fewer than 100 responses combined, thereby increasing chances for individual response bias.

Shark Species Composition by Area

Species Code	Shark Name	Number Reported All Areas	Percent Species Composition	Number Reported Virginia & Northward	Percent Species Composition Area V	Number Reported North Carolina to Florida	Percent Species Composition Area N	Number Reported Florida East Coast and Keys	Percent Species Composition Area F	Number Reported Gulf of Mexico	Percent Species Composition Area G	Number Reported Puerto Rico & U.S. Virgin Islands	Percent Species Composition Area P	Number Reported from Other Waters	Percent Species Composi Area O
1	Basking	2	.02	1	.02	0	0	0	U	1	.06	0	0	0	0
2	Blackfin	21	.22	0	0	0	0	7	.82	14	.81	0	0	0	0
4	Blacktip	649	6.88	6	.10	8?	20.97	82	9.65	477	27.60	2	28.57	0	0
6	Blue	4024	42.66	3533	60.34	10	2.56	1	.12	27	1.56	1	14.29	64	36.16
8	Brown	516	5.47	432	7.38	0	0	5	.59	22	1.27	0	0	52	29.38
10	Bull	199	2.11	1	.02	2	.51	74	8.71	121	7.00	1	14.29	0	0
11	Dog	68	.72	51	.87	1	.26	2	.24	14	.81	0	0	0	0
12	Dusky	645	6.84	503	8.59	8	2.04	38	4.47	59	3.41	0	0	17	9.60
14	Finetooth	1	.01	0	0	0	0	0	0	1	.06	0	0	0	0
16	Gray	45	.48	16	.27	5	1.28	13	1.53	11	.64	0	0	0	0
18	Hammerhead	958	10.16	158	2.70	67	17.14	320	37.65	390	22.57	0	0	20	11.30
19	Leopard	3	.03	2	.03	0	0	0	0	1	.06	0	0	0	0
20	Lemon	121	1.28	13	.22	10	2.56	75	8.82	23	1.33	0	0	0	0
22	Mako	734	7.78	629	10.74	24	6.14	26	3.06	37	2.14	2	28.57	8	4.52
23	Night	6	.06	0	0	0	0	6	.71	0	0	0	0	0	0
24	Nurse	93	.99	1	.02	0	0	57	6.71	34	1.97	0	0	1	.56
26	Porbeagle	1	.01	1	.02	0	0	0	0	0	0	0	0	0	0
28	Sand	730	7.74	118	2.02	159	40.66	95	11.18	351	20.31	0	0	6	3.39
30	Sandbar	87	.92	56	.96	1	.26	10	1.18	20	1.16	0	0	0	0
31	Sand Tiger	28	.30	20	.34	7	1.79	1	.12	0	0	0	0	0	0
32	Shovelnose	1	.01	0	0	0	0	0	0	1	.06	0	0	0	0
33	Sharpnose	1	.01	0	0	0	0	0	0	1	.06	0	0	0	0
34	Silky	1	.01	0	0	0	0	1	.12	0	0	0	0	0	0
36	Spinner	14	.15	0	0	2	.51	7	.82	5	.29	0	0	0	0
37	White	217	2.30	215	3.67	0	0	0	0	2	.12	0	0	0	0
38	Thresher	16	.17	14	.24	1	.26	0	0	1	.06	0	0	0	0
39	Whitetip	55	.58	0	0	2	.51	14	1.65	31	1.79	0	0	8	4.52
40	Tiger	197	2.09	85	1.45	10	2.56	16	1.88	84	4.86	1	14.29	1	.56
	TOTALS	9433		5855		391		850		1728		7		177	

86

Figure 49 plots the percent shark species composition for all areas combined.
These data combine the results of all respondents who identified shark species
on their questionnaire. Note that blue sharks comprise over 42% of the total
recreational catch and that seven "species" (blacktip, blue, brown, dusky,
hammerhead, mako, and sand) make up over 87% of the total catch. According to
these data, hammerheads are the second most commonly caught group of sharks.
Out of the 28 species identified by respondents, only 11 comprised over 1% of
the total recreational catch, and 13 comprised less than 0.5% of the catch.

Figure 49

PERCENT SHARK SPECIES COMPOSITION FOR ALL AREAS COMBINED
BASED ON THE TOTAL NUMBER OF RESPONDENTS IDENTIFYING SHARKS

100
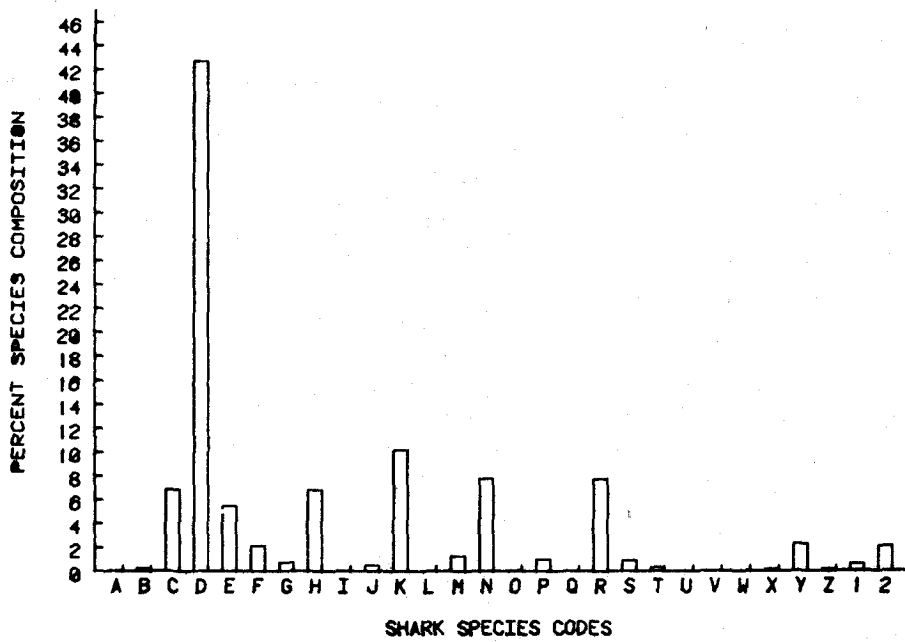
Figure 50 plots shark species composition for waters Virginia and northward.
In this area, blue sharks comprised over 60% of the recreational catch with
three other species (browns, duskies, and makos) making up another 26+%.
These four groups comprised over 87% of the identified shark catch for this
area. The data for white sharks are believed to be a product of the "JAWS"
craze rather than realistic data.

Figure 51 plots the percent shark species composition for North Carolina to
Florida. Sand sharks were the most commonly reported species for this area
making up over 40% of the catch. Makos, hammerheads, and blacktips made up
another 44% of the catch, bringing the total of these four species groups to
almost 85% of the total catch.

Figure 50

PERCENT SPECIES COMPOSITION FOR SHARKS
CAUGHT VIRGINIA AND NORTHWARD
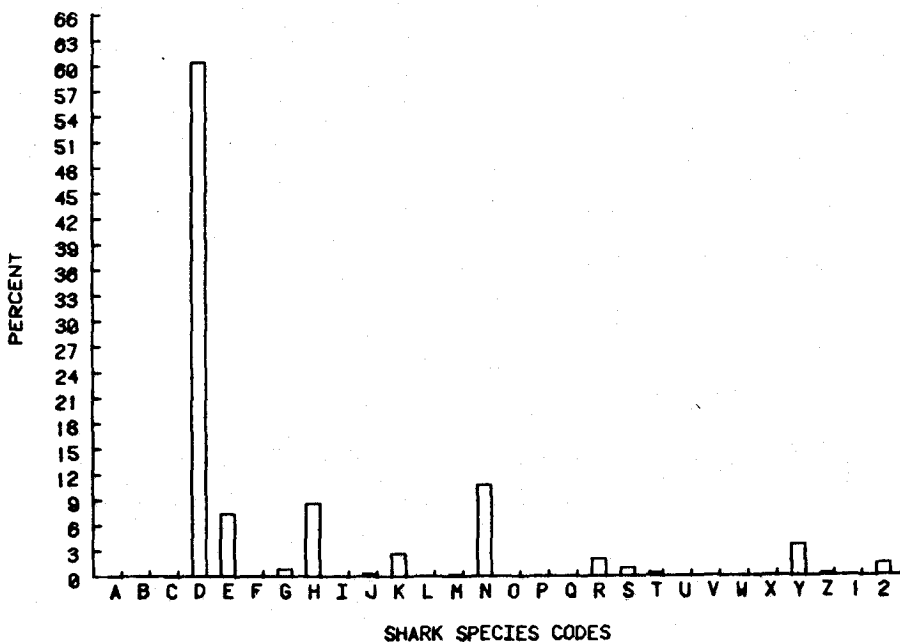
Figure 51

PERCENT SPECIES COMPOSITION FOR SHARKS
CAUGHT FROM NORTH CAROLINA TO FLORIDA
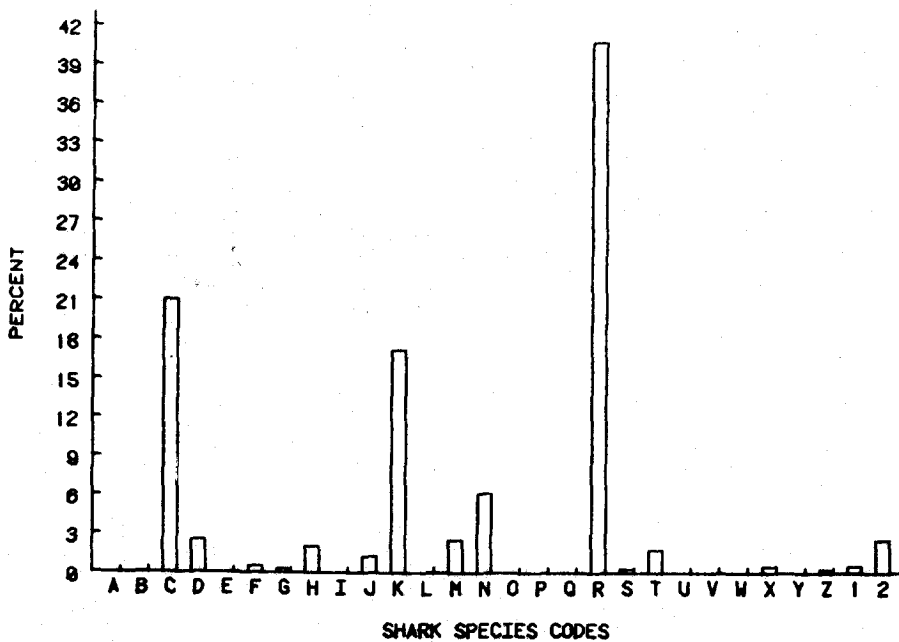
Figure 52 plots the percent species composition for sharks caught off the
Florida East Coast and Keys. Hammerheads were reported most frequently and
comprise over 37% of the number of sharks reported. Diversity appears higher
in this area as seven other species (black-tip, bull, dusky, lemon, nurse,
mako, and sand sharks) were reported fairly frequently. These eight species
comprised about 87% of the identified recreational catch.

Figure 53 plots the percent species composition of sharks caught in the Gulf
of Mexico. Blacktips were the most commonly reported with hammerheads second
and sand sharks third. These three groups made up over 70% of the identified
catch. Two other species (bull and tiger sharks) were fairly common making up
12% of the catch. These five species groups made up over 82% of the
identified catch.

Figure 52

PERCENT SPECIES COMPOSITION FOR SHARKS
CAUGHT OFF THE FLORIDA EAST COAST AND KEYS
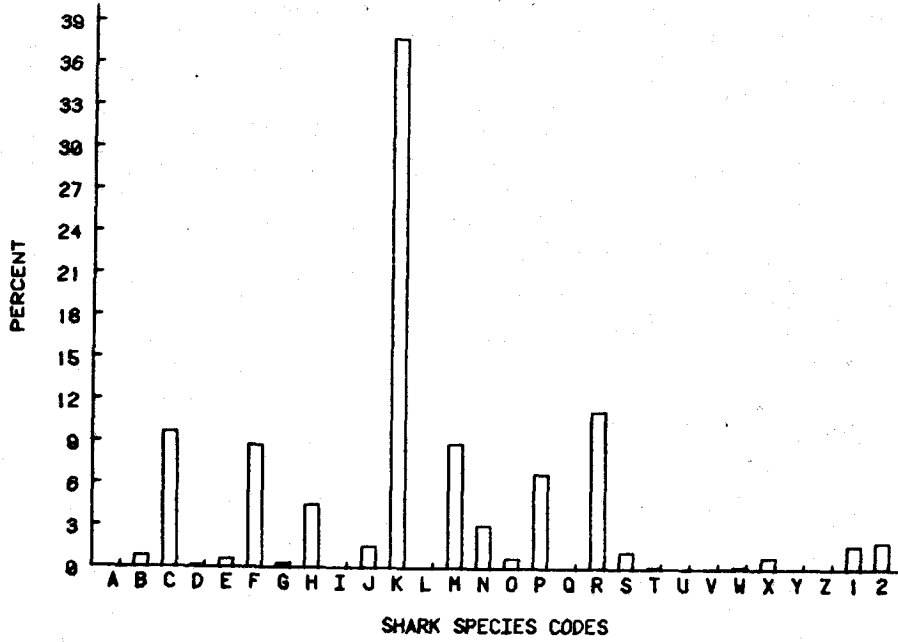
Figure 53

PERCENT SPECIES COMPOSITION OF SHARKS
CAUGHT IN THE GULF OF MEXICO
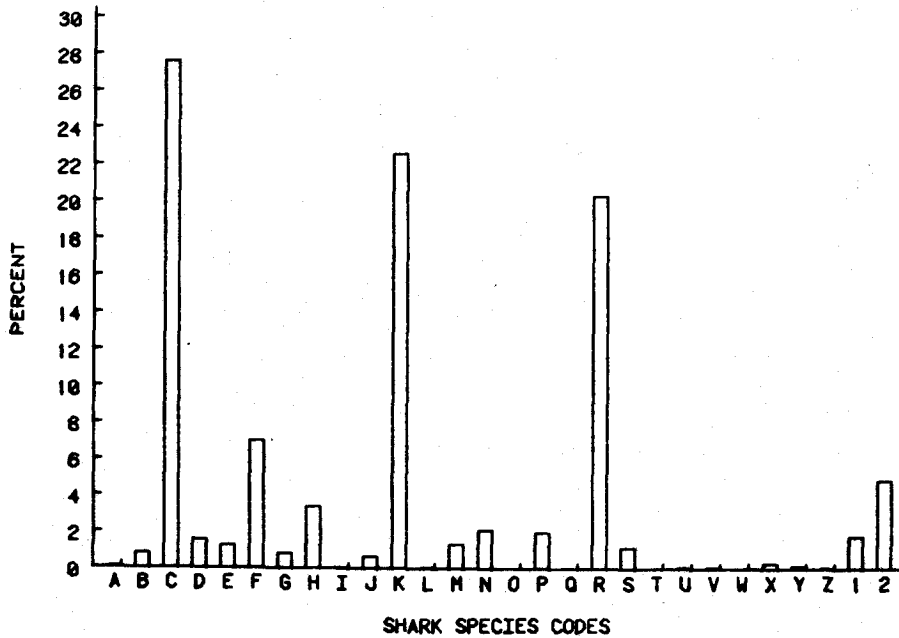
Figure 54 plots the percent species composition of the sharks caught near

Puerto Rico and the U.S. Virgin Islands. The obvious feature of this area is

that only five species were reported: blacktips, blues, bulls, makos, and

tigers. Only seven sharks were identified by the four respondents identifying

sharks in this area.

Figure 55 plots the percent species composition of sharks caught in waters not

included in another survey area. The number of species reported and the

number of respondents identifying sharks were small.

Figure 54

PERCENT SPECIES COMPOSITION FOR SHARKS
CAUGHT OFF PUERTO RICO AND THE U.S. VIRGIN ISLANDS
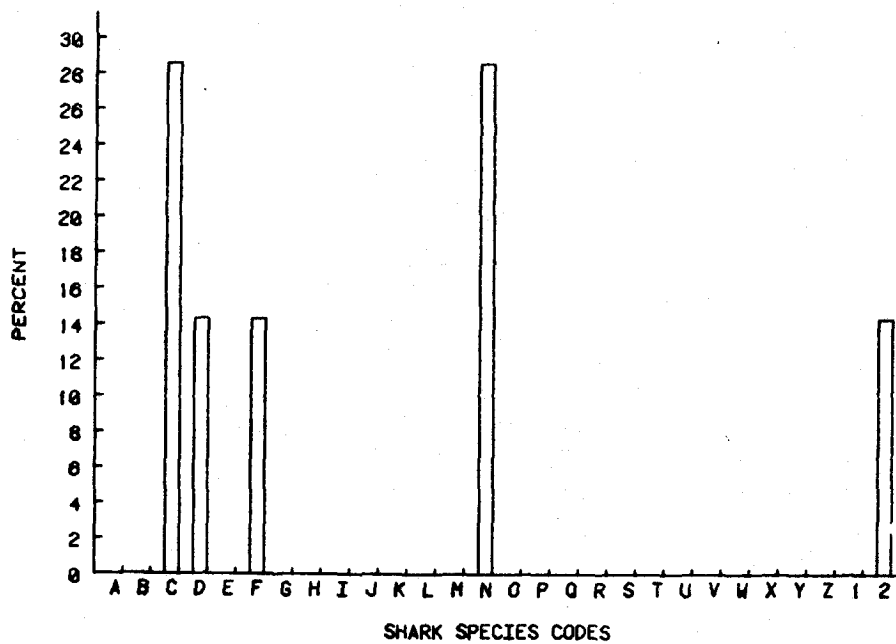
Figure 55

PERCENT SPECIES COMPOSITION FOR SHARKS
CAUGHT IN OTHER WATERS
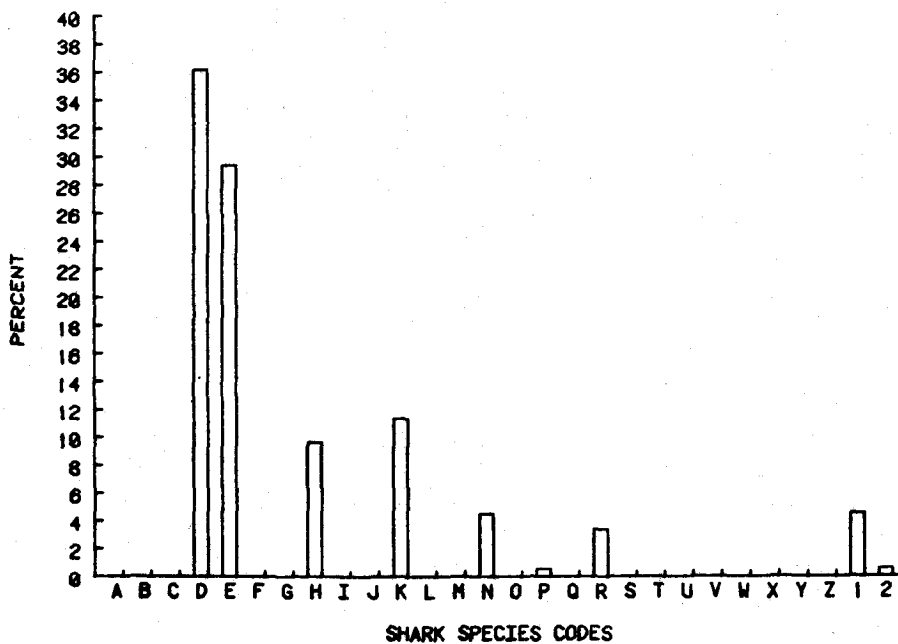
Shark Effort Data Analyses

   Estimates of the number of boats in the shark fishery can be made by

using the same methods and assumptions as discussed in the Billfish Effort

Data Analyses section. The first method for estimating the number of boats in

a fishery used the estimated number of boats in the billfish/shark fishery on

a state-by-state basis (Table 7) multiplied by the average percent of shark

fishing (54.2%) in the population. This calculation (25,805 x 0.542)

estimates that 13,986 boats participate in the U.S. recreational shark

fishery. The second method utilized boat size classes rather than state-by-

state calculations. For each size class, the estimated number of boats in the

billfish/shark fishery was multiplied by the percent of shark fishing in the

responding population (Table 8). This method produces an estimate of 14,139

boats in the recreational shark fishery in the study area (Table 18). The

third method for estimating the number of boats in the shark fishery used data

on the average catch per boat and the estimated number of fish caught

(Appendix II). Table 19 summarizes the data used in these calculations and

estimates the number of boats in the shark fishery as 19,730. Figure 56 plots

the average catch per boat by boat size class, and Figure 57 plots the

estimated number of boats in the shark fishery by boat size class. The last

method for estimating the number of boats in the shark fishery utilizes

average catch per boat by area and estimated total catch by area (Appendix

II). Table 20 summarizes the data used in these calculations, Figure 58 plots

the average number of sharks caught per boat by area, and Figure 59 plots the

estimated number of boats in the fishery by area.

Table 18

Estimates of Shark Fishing Boats Based on Size
Class Response Data

Boat Size In Feet	Number Responses Reporting Days Fished for Sharks	Percent Shark Fishing	Estimated Number of Boats Fishing for Sharks
18-19	49	45.4	1152
20-25	435	59.6	8063
26-34	480	54.9	3045
35-45	134	44.2	1074
46-65	7	25.9	153
DE/PR	29	55.8	652
TOTALS	1134	54.2	14139

Table 19

Estimates of the Number of Boats in the Shark Fishery Based on Average Catch Statistics
by Boat Size Class

Boat Size in Feet	Estimated Number of Sharks Caught (Appendix II)	Number Fishermen Reporting	Number Sharks Caught	Average Number Caught Per Boat	Estimated Number of Boats in the Shark Fishery
18-19	16418	49	445	9.1	1804
20-25	103667	435	4351	10.0	10367
26-34	85994	480	7968	16.6	5180
34-45	19378	134	1515	11.3	1715
46-65	1945	7	95	13.6	143
DE/PR	3020	29	169	5.8	521
Totals	230442	1134	14543	12.8	19730

Figure 56 plots the average number of sharks caught per boat by boat size class. The data show that 26-34 foot boats appear to catch the highest average number of sharks per boat.

Figure 57 plots the estimated number of boats in the shark fishery by boat size class. These calculations were based on the average catch per boat by respondents reporting days fished information. These data show that 20-25 foot boats comprise almost 53% of the shark fishing boats, and that 20-34 foot boats account for almost 79% of the total number of boats.

Figure 56

AVERAGE NUMBER OF SHARKS CAUGHT PER BOAT BY BOAT SIZE CLASS
(BASED ON THOSE REPORTING DAYS FISHED)
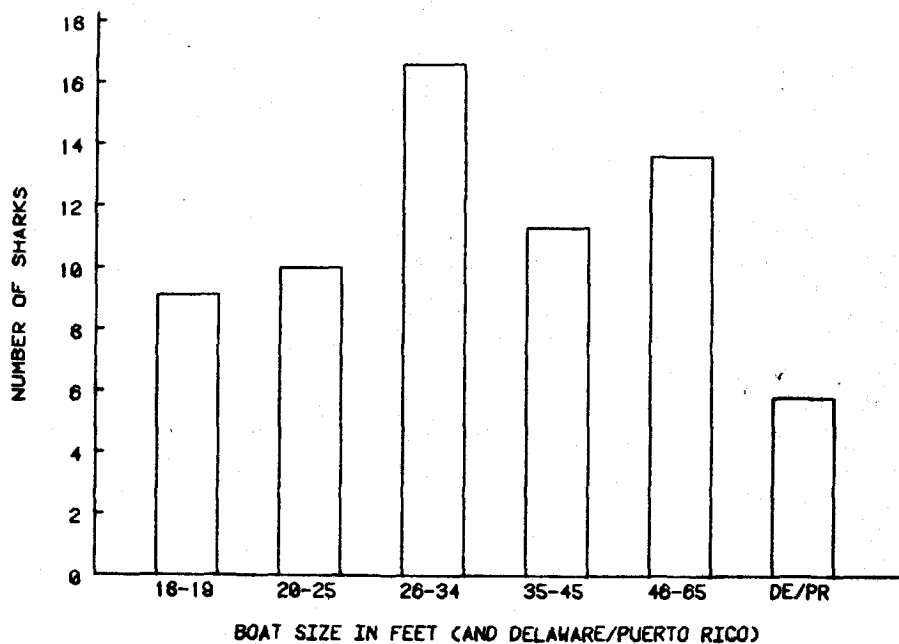
Figure 57

ESTIMATED NUMBER OF BOATS IN THE SHARK FISHERY BY BOAT SIZE CLASS
BASED ON AVERAGE CATCH OF THOSE REPORTING DAYS FISHED
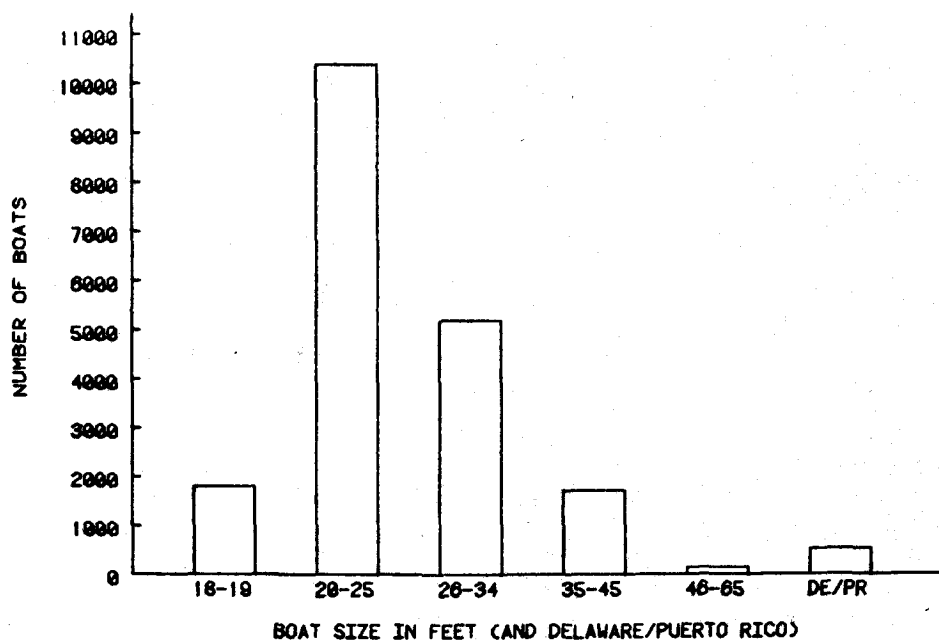
Table 20

Estimates of the Number of Boats in the Shark Fishery Based on Average Catch Statistics by Fishing Area

Area Fished	Estimated Number of Sharks Caught (Appendix II)	Number Reporting Days Fished for Sharks	Number of Sharks Caught	Average Number of Sharks Caught per Boat	Estimated Number of Boats in the Shark Fishery
Virginia and Northward	124226	549	8853	16.1	7716
North Carolina to Florida	16296	73	654	9.0	1811
Florida east coast and Keys	40184	167	1573	9.4	4275
Gulf of Mexico	46405	299	3107	10.4	4462
Puerto Rico and U.S. Virgin Islands	776	14	43	3.1	250
Other Waters	2536	32	313	9.8	259
Totals	230423	1134	14543	12.8	18773

Figure 58 plots the average number of sharks caught per boat by area fished. This histogram shows that boats fishing Virginia and northward appear to catch the most sharks per boat. As seen in the area species composition graphs, over 60% of these were blue sharks.

Figure 59 plots the estimated number of boats in the shark fishery by area fished. These data show that over 41% of the estimated number of shark fishing boats fish in waters Virginia and northward.

Figure 58
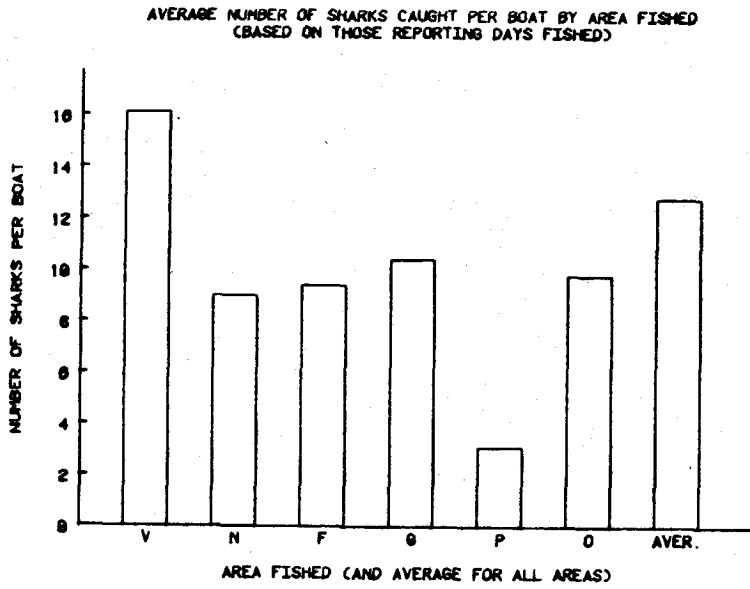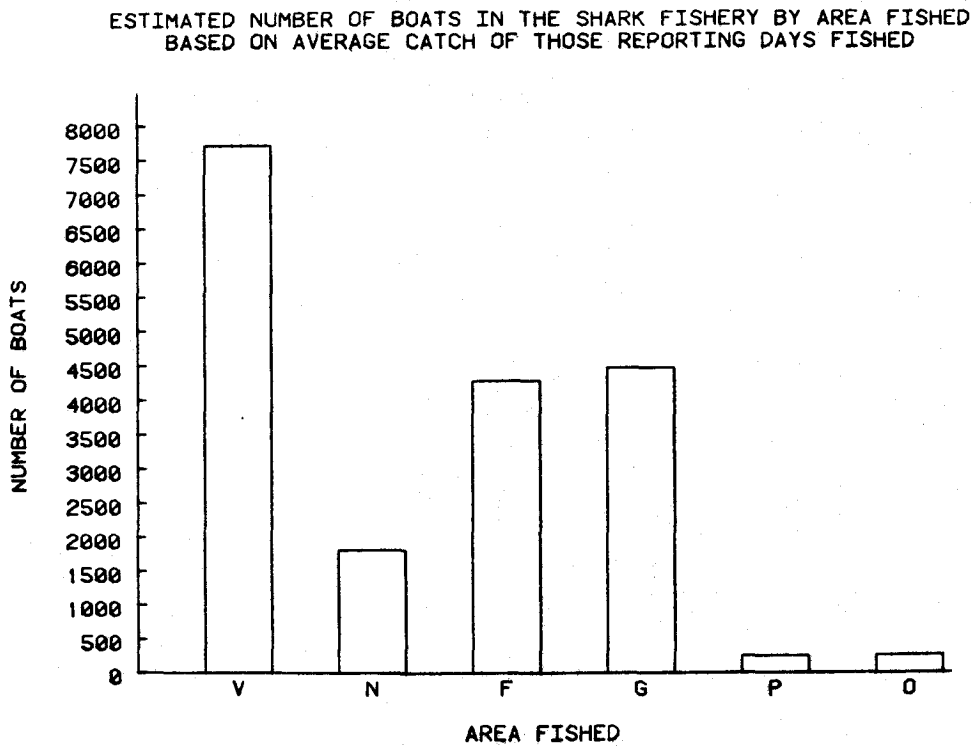
AVERAGE NUMBER OF SHARKS CAUGHT PER BOAT BY AREA FISHED
(BASED ON THOSE REPORTING DAYS FISHED)

NUMBER OF SHARKS PER BOAT

AREA FISHED (AND AVERAGE FOR ALL AREAS)

Figure 59

ESTIMATED NUMBER OF BOATS IN THE SHARK FISHERY BY AREA FISHED
BASED ON AVERAGE CATCH OF THOSE REPORTING DAYS FISHED

NUMBER OF BOATS

AREA FISHED

114

Other effort data analyses include calculations of the average number of days fished per boat, average number of days fished per shark caught, average number of sharks caught per day fished, and estimates of the total number of days fished in the recreational shark fishery. As in previous analyses, calculations can be made by boat size or area fished. All effort data analyses are based on respondents who reported days fished information. Methods used for shark analyses are the same as those used for billfish. Table 21 and Figures 60 through 63 present effort data by boat size class for number of days fished per boat, number of days fished per sharks caught, number of sharks caught per day fished, and total number of days fished. The estimated total number of days fished (146,838) was calculated by multiplying the average number of days fished times the estimated number of boats in the fishery (Table 18).

Table 21

Estimates of Effort Spent Fishing for Sharks by Boat Size Class

Boat Size in Feet	Number Reporting	Number Sharks Caught	Number Days Fished	Average Number Days Fished per Boat	Average Number Days Fished per Shark Caught	Average Number Shark Caught per Day Fished	Estimated Total Number of Days Fished
18-19	49	445	867	17.7	1.9	.51	20390
20-25	435	4351	3802	8.7	.9	1.14	70148
26-34	480	7968	4854	10.1	.6	1.64	30755
35-45	134	1515	2127	15.9	1.4	.71	17077
46-65	7	95	131	18.7	1.4	.73	2861
DE/PR	29	169	248	8.6	1.5	.68	5607
Totals	1134	14543	12029	10.6	.8	1.21	146838

Figure 60 plots the average number of days fished for sharks by boat size class. These data show that 20-34 foot boats appear to fish fewer days for sharks than other size classes.

Figure 61 plots the average number of days fished per shark caught by boat size class. This shows that 20-34 foot boats seem to spend less time to catch a shark than any other size class.

Figure 60

AVERAGE NUMBER OF DAYS FISHED FOR SHARKS PER BOAT BY BOAT SIZE CLASS
(BASED ON THOSE REPORTING DAYS FISHED)
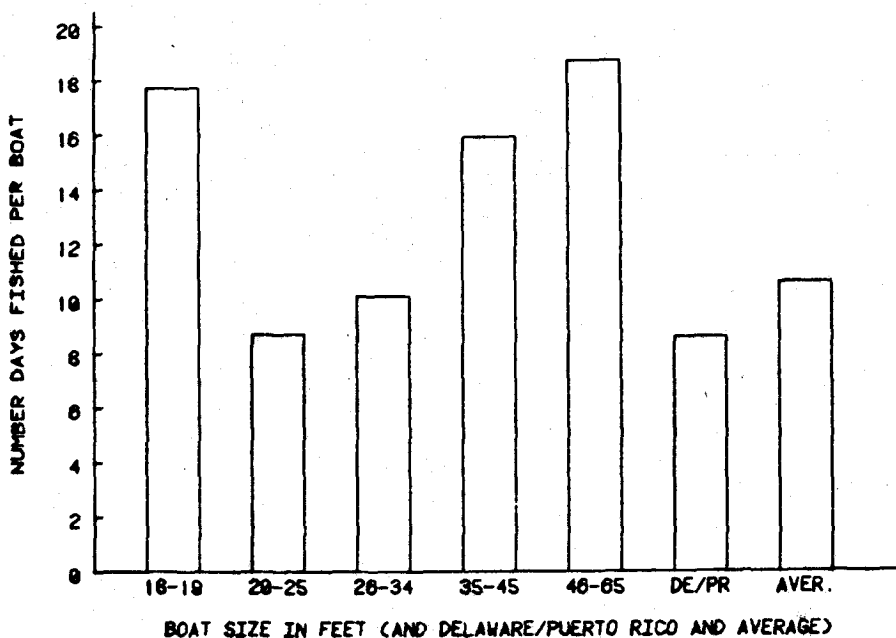
Figure 61

AVERAGE NUMBER OF DAYS FISHED PER SHARK CAUGHT BY BOAT SIZE CLASS
(BASED ON THOSE REPORTING DAYS FISHED)

118
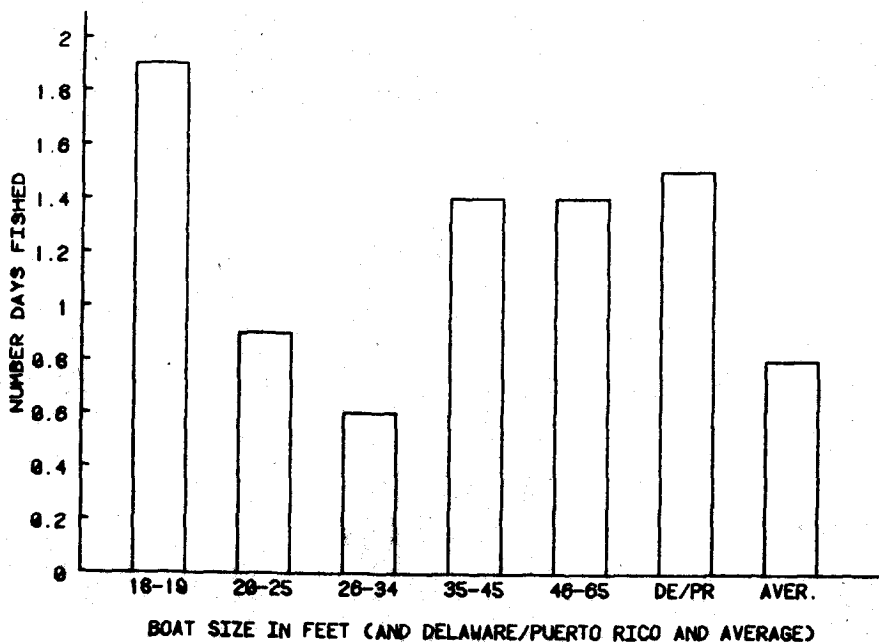
Figure 62 plots the average number of sharks caught per day fished by boat size class. The average number of sharks caught per day fished seems fairly constant for all groups except 20-34 foot boats which appear to have a higher success rate.

Figure 63 plots the estimated number of days fished for sharks by boat size class. These data show that 20-25 foot boats were responsible for almost 48% of the shark fishery effort, and that 20-34 foot boats were used in almost 69% of the shark fishing effort.

Figure 62

AVERAGE NUMBER OF SHARKS CAUGHT PER DAY FISHED BY BOAT SIZE CLASS
(BASED ON THOSE REPORTING DAYS FISHED)
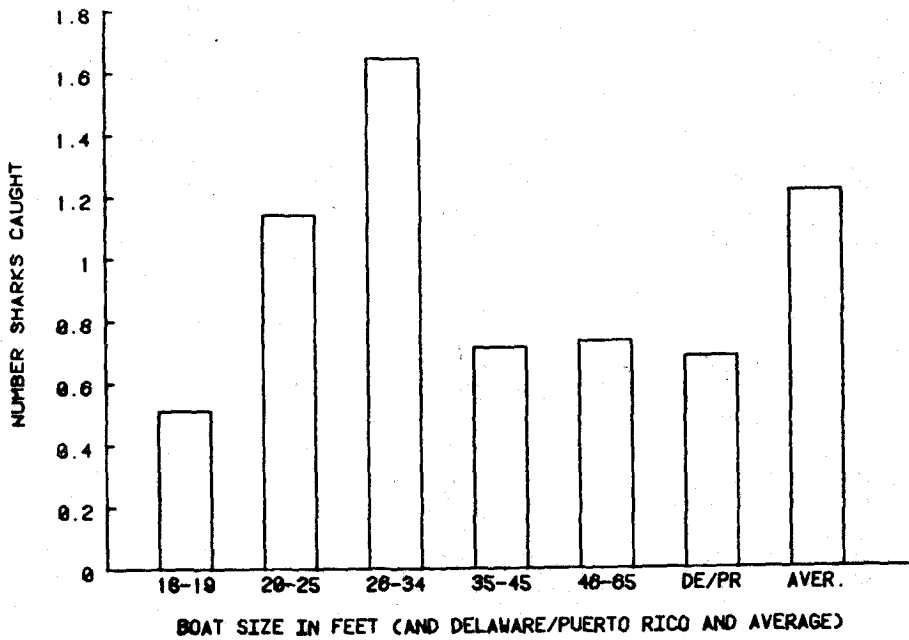
Figure 63

ESTIMATED NUMBER OF DAYS FISHED FOR SHARKS BY BOAT SIZE CLASS
(BASED ON THOSE REPORTING DAYS FISHED)
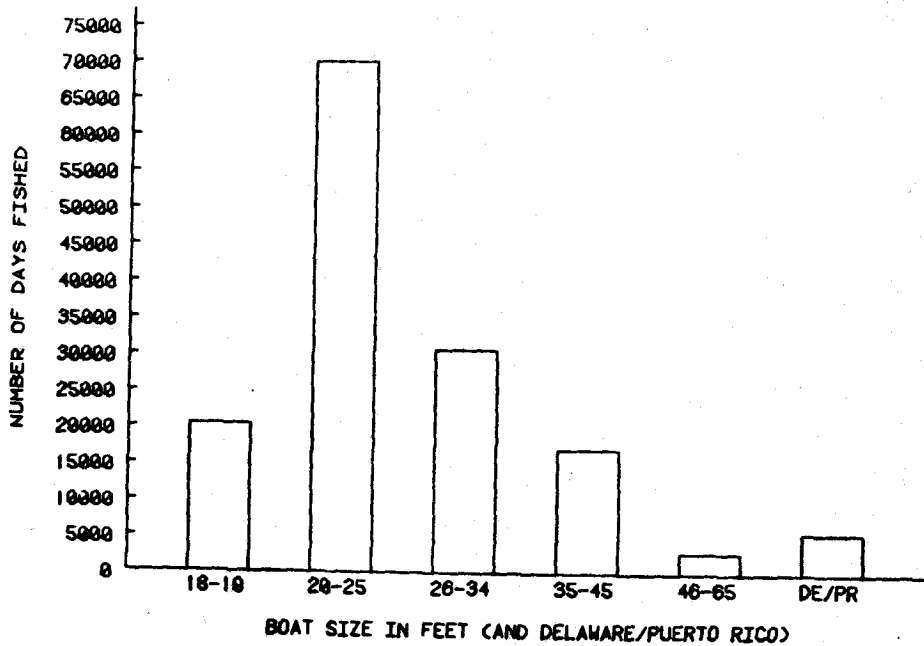
Estimates of the total number of days fished per area (Table 22) were calculated by multiplying the average number of days fished per boat in each area times the estimated number of boats fishing that area (Table 20). The estimate for total effort for all areas combined (213,738) was obtained by summing all area estimates. Figures 64 through 67 plot Table 22 statistics for days fished per boat, days fished per shark caught, number of sharks caught per day fished, and estimated number of days fished by area.

The final method to estimate the total effort for the recreational shark fishery that will be presented in this report utilized the total estimated number of sharks caught (Appendix II) and the average shark catch per day. Using this calculation (230,423 / 1.21) an estimate of 190,432 days fished is obtained.

Table 22

Estimates of Effort Spent Fishing for Sharks by Area Fished

Area Fished	Number Shark Fishermen Reporting	Number Sharks Caught	Number Days Fished	Average Number Days Fished per Boat	Average Number Days Fished per Shark Caught	Average Number Sharks Caught per Day Fished	Total Estimated Number of Days Fished
Virginia and Northward	549	8853	4865	8.9	.5	1.82	68672
North Carolina to Florida	73	654	741	10.2	1.1	.88	18472
Florida East Coast and Keys	167	1573	2949	17.7	1.9	.53	75668
Gulf of Mexico	299	3107	3149	10.5	1.0	.99	46851
Puerto Rico and U.S. Virgin Islands	14	43	148	10.6	3.4	.29	2650
Other Waters	32	313	177	5.5	.6	1.77	1425
Totals	1134	14543	12029	10.6	.8	1.21	213738

Figure 64 plots the average number of days fished for sharks per boat for each of the areas surveyed. These data show that the average number of days fished per boat was about the same for all areas except the Florida East Coast and Keys where more time was spent shark fishing. Boats billfishing in this area also appeared to show a higher number of days fished than in any other area (Figure 43).

Figure 65 plots the average number of days fished per shark caught for each area surveyed. Fishing in area "V" appears to require the least amount of effort to catch a shark, which is probably due to the large number of blue sharks caught in this area.

Figure 64

AVERAGE NUMBER OF DAYS FISHED FOR SHARKS PER BOAT BY AREA FISHED
(BASED ON THOSE REPORTING DAYS FISHED)
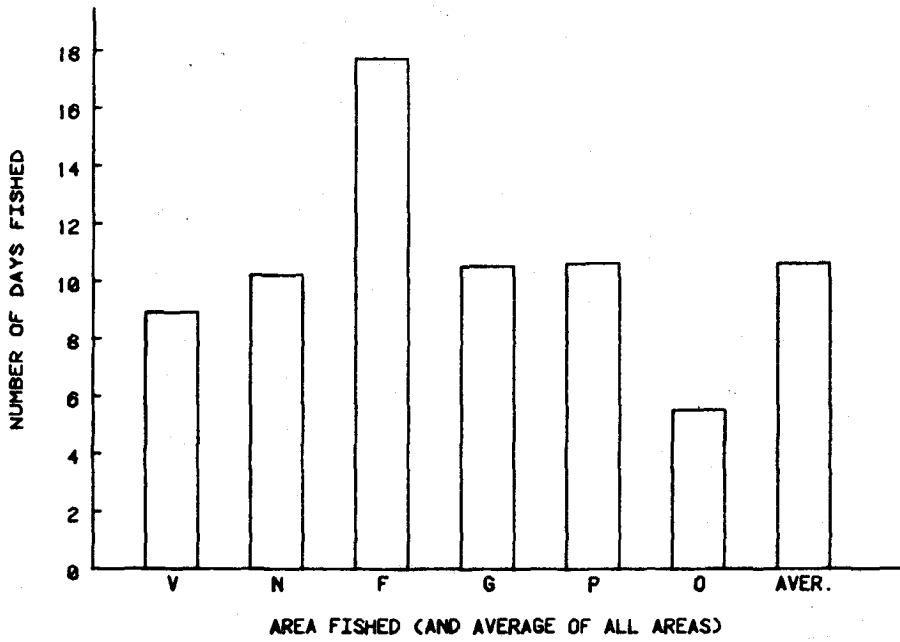
Figure 65

AVERAGE NUMBER OF DAYS FISHED PER SHARK CAUGHT BY AREA FISHED
(BASED ON THOSE REPORTING DAYS FISHED)
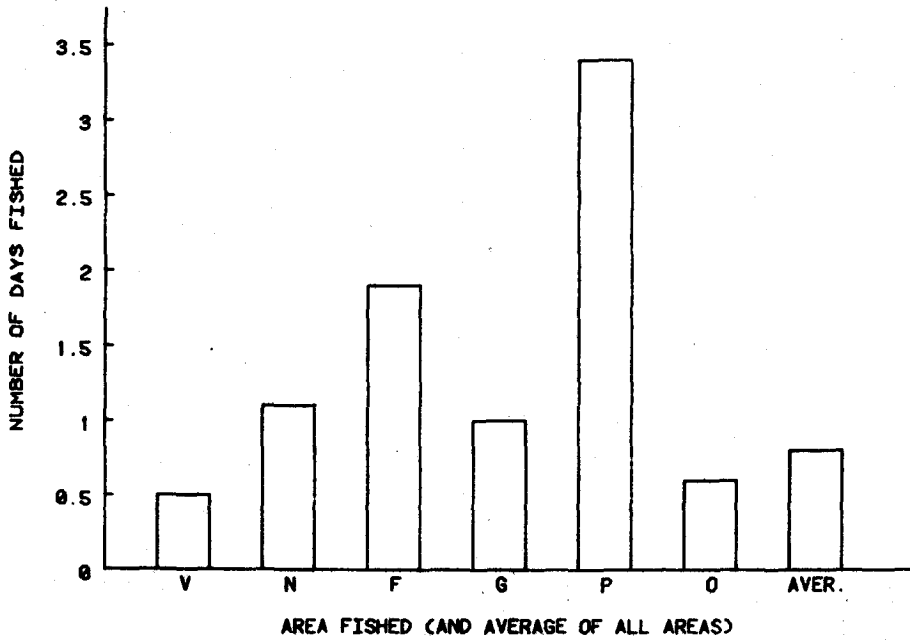
Figure 66 plots the average number of sharks caught per day fished for each surveyed area. These data show that the catch rate for area "V" approaches two sharks per day, possibly a result of the abundance of blue sharks in this area.

Figure 67 plots the estimated number of days spent fishing for sharks in each of the areas surveyed. It appears that almost 68% of all shark fishing is done in areas "V" and "F", and that about 57% of all shark fishing is done off Florida and in the Gulf of Mexico.

Figure 66

AVERAGE NUMBER OF SHARKS CAUGHT PER DAY FISHED BY AREA FISHED
(BASED ON THOSE REPORTING DAYS FISHED)

AREA FISHED (AND AVERAGE OF ALL AREAS)
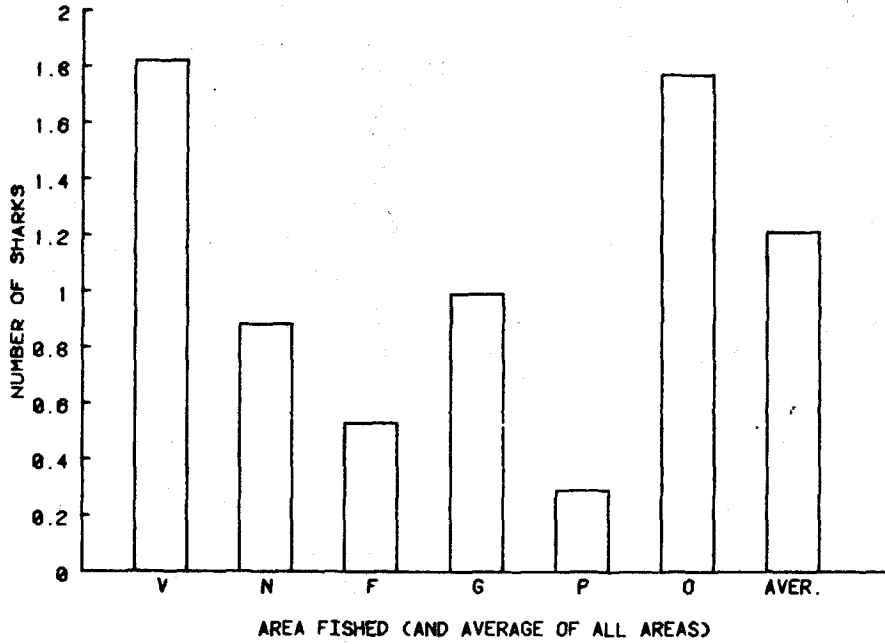
Figure 67

ESTIMATED NUMBER OF DAYS SPENT SHARK FISHING BY AREA FISHED
(BASED ON THOSE REPORTING DAYS FISHED)

AREA FISHED
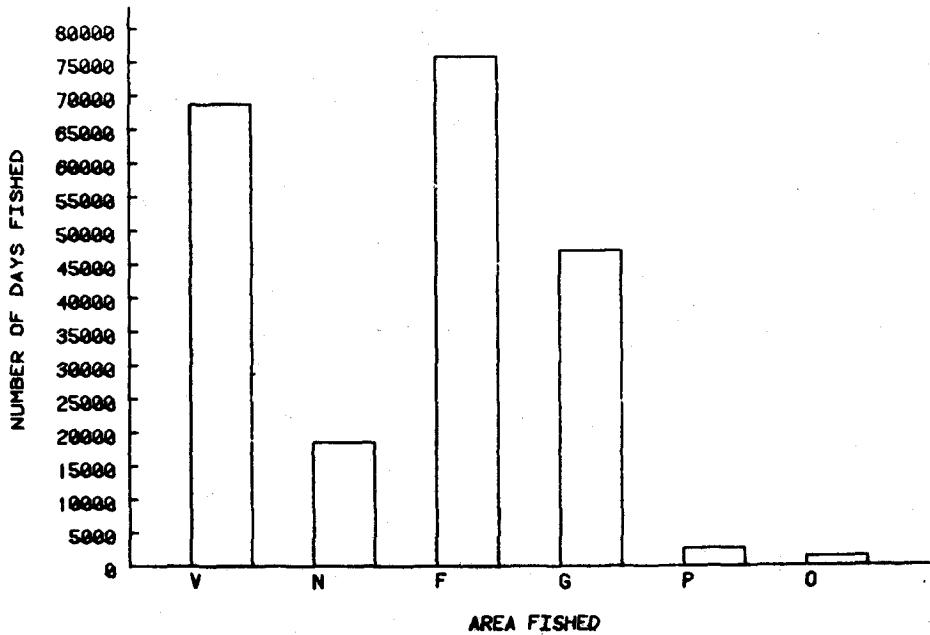
Other Shark Data Analyses

Charter versus noncharter and tournament versus nontournament catch of sharks will be only briefly summarized. Table 23 identifies most of the readily identifiable characteristics of the charter boat versus noncharter boat catch of sharks. It is interesting to note that although charter boats fish approximately twice as many days per boat as noncharter boats, their success rate is no better than noncharter boats. This is quite different from the billfish fishery where charter boats were about twice as successful as noncharter boats.

Comparisons between respondents who entered fish in tournaments and those who did not enter fish in shark tournaments produce some interesting statistics, as summarized in Table 24. Data show that tournament boats fish only slightly more often than nontournament boats but catch approximately three times as many fish per boat. According to these data, tournament boats catch an average of 2.3 sharks per day as compared to 0.9 for nontournament boats. Tournament people entered only 33.4% of their total shark catch in tournaments. Tournament boats were about 16% of the total number of boats reporting, but their total catch was about 36.5% of the total shark catch of all respondents reporting days fished information.

Table 23

Charter Versus Noncharter Shark Catch

	Charter	Noncharter
Number of Fishing Events Reported	95	1039
Number of Sharks Caught	2155	12388
Number of Days Fished for Sharks	2031	10016
Average Number of Sharks Caught per Boat	22.7	11.9
Average Number of Days Fished per Boat	21.2	9.6
Average Number of Sharks Caught per Day	1.1	1.2
Average Number of Days Fished per Shark Caught	.9	.8

Table 24

Tournament Versus Nontournament Shark Catch

	Tournament	Nontournament
Number Reporting	182	952
Number of Sharks Caught	5310	9233
Number of Days Fished	2300	9729
Average Number Sharks Caught per Boat	29.2	9.7
Average Number of Days Fished per Boat	12.6	10.2
Average Number Sharks Caught per Day	2.3	.9
Average Number of Days Fished per Sharks Caught	.43	1.05

SUMMARY AND CONCLUSIONS

The principal objective of this survey was to estimate the total number of billfish caught in the western North Atlantic Ocean from recreational boats during a 12-month period, May 1, 1977 through April 30, 1978. The results obtained were: 85,869 ± 15,502 billfish at the 95% confidence interval.

Secondary objectives and results obtained were:

1) Collect catch statistics for five species of billfish.

Results:

Species	Caught[1]	Boated[2]
Blue Marlin	6745 ± 805 (S.E.)*	2452 ± 268 (S.E.)
White Marlin	15649 ± 1725 (S.E.)	4787 ± 419 (S.E.)
Sailfish	60008 ± 7497 (S.E.)	15699 ± 1985 (S.E.)
Spearfish	467 ± 162 (S.E.)	397 ± 153 (S.E.)
Swordfish	3000 ± 473 (S.E.)	2344 ± 430 (S.E.)

* S. E. = One Standard Error

1   = All fish whether kept or released

2   = Fish not released, i.e., killed

2) Collect data on recreational catch of sharks larger than 20 pounds.

   Results:

   230423 ± 22025 (S.E.) Caught : 667786 ± 5533 (S.E.) Boated

3) Collect effort data for billfish and sharks.

   Results:

   a. 67.4% of the responding fishermen reported fishing for billfish

   b. 54.2% of the responding fishermen reported fishing for sharks

   c. 21.6% of the responding fishermen reported fishing for both

   d. estimates of the number of boats in the billfish fishery ranged
      from 17,373 to 21,980

   e. estimates of the number of boats in the shark fishery ranged from
      14,139 to 19,730

   f. estimates of total number of days spent billfishing ranged from
      247,743 to 298,797

   g. estimates of total number of days spent shark fishing ranged from
      146,838 to 213,738

4) Collect tournament and nontournament catch of both billfishes and
   sharks.

   Results:

   a. approximately 12% of all reported billfish were entered in
      tournaments

   b. approximately 12% of all sharks reported were caught in
      tournaments

   c. the tournament reported billfish were about one fourth of the
      total catch of the respondents reporting tournament fish

   d. tournament sharks were about one third of the total shark catch of
      those reporting tournament sharks

5) Identify characteristics of fisheries that may aid in future survey designs. This objective was met in many ways. Data now exist on catch by area fished, boat size, boat type (charter versus noncharter), incidence in the population, variances of the population, differences between mail and phone respondent, and many other factors that can be important in survey design. (Preliminary t-tests on data group summaries showed that there were no apparent differences between mail and phone respondents. This will be further examined by TIMS personnel at a later date.)

ACKNOWLEDGMENTS

STUDY TEAM COMPOSITION

This study was conducted under the direction of Mr. H. Erich Groess, Acting Chief of the Technical and Information Management Services, Southeast Fisheries Center. Principal members of the study team were:

Mr. David C. Hamm - Principal Analyst

Ms. Beany M. Slater - Survey Design

Contributing members in alphabetical order were:

Mr. Edward E. Burgess

Mr. Thomas Chewning

Mr. Ramon Conser

Mr. Douglas Felton

Mr. Jonathan Houghton

Dr. Larry L. Massey

Mr. Kimrey Newlin

Mr. Wayne Poole

Mr. Darrell Tidwell

APPENDIX I

SURVEY RESPONSE DATA SUMMARIES

The following report is a presentation of survey response data by state and boat size classification. The report for each state is divided into four sections. The parameters within these sections are described below:

Sample Selection Data

1. Population Size - the number of boats registered in this state that are capable of fishing for billfish according to the requirements of this survey.

2. Sampling Fraction - the fraction used to select a sample from each stratum.

3. Sample Selected - the number of registrations selected from the population to represent each stratum, i.e.,

Population X Sampling Fraction.

Mail Response Information

1. Total Number of Mail Respondents - includes all responses received by mail except nondeliverables and questionnaires returned completely blank.

2. % Response - the percentage of sample selected that were returned by mail, i.e.,

Total Number of Mail Respondents divided by Sample Selected X 100.

3. % Response Nondels Removed - the percentage of questionnaires that were returned by mail when number of undeliverable questionnaires was subtracted from the sample size. Since the boats represented by the undeliverable questionnaires were not actually sampled by mail, a true mail response rate can be calculated by subtracting nondeliverables from the samples selected, i.e.,

Total Number of Mail Respondents divided by (Sample Selected minus Number of Nondeliverables) X 100.

4. Number Responding First Mailing - that portion of the total number of mail respondents who returned their questionnaire from the first mailing.

5. % Responding First Mailing - percent of the samples selected who responded to the first mailing, i.e.,

Number Responding First Mailing divided by Sample Selected X 100.

6. Number Responding Second Mailing – that portion of the total number of mail respondents who returned their questionnaire from the second mailing.

7. % Responding Second Mailing – percent of the sample selected who responded to the second mailing i.e.,

    Number Responding Second Mailing divided by Sample Selected X 100.

8. Number of Nondeliverables – total number of questionnaires returned undelivered because of incorrect, improper, or inadequate addressing.

9. % Nondeliverables – percent of the sample selected that was returned undelivered i.e.,

    Number of Nondeliverables divided by Sample Selected X 100.

Phone Survey Information

1. Total Not Responding to Mailings – total number of nonrespondents, including nondeliverables.

2. Subsampling Fraction – the fraction used to select a phone survey subsample from each stratum.

3. Subsample Selected – the number of registrations selected from the total not responding to mailings.

4. Number Completed Interviews – the number of people who were actually interviewed during the phone survey.

5. % Completed Interviews – the response rate of the phone survey, i.e.,

    Number Completed Interviews divided by Subsample Selected X 100.

Total Response Information

1. Number of Respondents – all responding by either phone or mail, i.e.,

    Total Number of Mail Respondents + Number Completed Interviews.

2. % Response – final response rate of the survey, i.e.,

    Number of Respondents divided by Sample Selected X 100.

3. Number of Nonrespondents – total number not responding to the survey either by mail or phone, i.e.,

    Sample Selected – Number of Respondents

4. Total Number Who Did Not Fish - those respondents who answered the questionnaire by saying they did not fish for billfish or sharks during the study period.

5. % Who Did Not Fish - percent of the number of respondents who answered the questionnaire and did not fish, i.e.,

    Total Number Who Did Not Fish divided by Number of Respondents X 100.

6. Total Number Who Did Fish - the Number of Respondents who said they did fish for billfish or sharks during the study period.

7. % Who Did Fish - percent of the number of respondents who fished for billfish or sharks, i.e.,

    Total Number Who Did Fish divided by Number of Respondents X 100.

   Notice that the sum of Total Number Who Did Not Fish and Total Number Who Did Fish does not usually equal the Number of Respondents. The shortage in this total is the number of respondents who said they had sold their boats or that the owner had died, i.e.,

    Number of Respondents - (Total Number Who Did Not Fish + Total Number Who Did Fish) = Total of Sold & Dead.

RESPONSE RESULTS OF THE RECREATIONAL BILLFISH SURVEY
ALABAMA

| SURVEY ELEMENTS | BOAT SIZE (IN FEET) | | | | | |
	18-19	20-25	26-34	35-45	46-65	TOTALS
SAMPLE SELECTION						
POPULATION SIZE	0	6993	1749	650	195	9587
SAMPLING FRACTION	1/00	1/09	1/03	1/03	1/09	
SAMPLE SELECTED	0	777	583	217	22	1599

****

MAIL RESPONSE INFORMATION						
TOTAL NUMBER OF MAIL RESPONDENTS	0	403	283	121	16	823
% RESPONSE	0.0%	51.9%	48.5%	55.8%	72.7%	51.5%
% RESPONSE NONDELS REMOVED	0.0%	60.1%	55.7%	63.7%	84.2%	59.3%
NUMBER RESPONDING FIRST MAILING	0	250	169	76	7	502
% RESPONDING FIRST MAILING	0.0%	32.2%	29.0%	35.0%	31.8%	31.4%
NUMBER RESPONDING SECOND MAILING	0	153	114	45	9	321
% RESPONDING SECOND MAILING	0.0%	19.7%	19.6%	20.7%	40.9%	20.1%
NUMBER OF NONDELIVERABLES	0	106	75	27	3	211
% NONDELIVERABLES	0.0%	13.6%	12.9%	12.4%	13.6%	13.2%

****

PHONE SURVEY INFORMATION						
TOTAL NOT RESPONDING TO MAILINGS	0	374	300	96	6	776
SUBSAMPLING FRACTION	1/00	1/09	1/03	1/03	1/03	
SUBSAMPLE SELECTED	0	43	101	33	2	179
NUMBER COMPLETED INTERVIEWS	0	21	50	18	0	89
% COMPLETED INTERVIEWS	0.0%	48.8%	49.5%	54.5%	0.0%	49.7%

****

TOTAL RESPONSE INFORMATION						
NUMBER OF RESPONDENTS	0	424	333	139	16	912
% RESPONSE	0.0%	54.6%	57.1%	64.1%	72.7%	57.0%
NUMBER OF NONRESPONDENTS	0	353	250	78	6	687
TOTAL NUMBER WHO DID NOT FISH	0	381	287	132	14	814
% WHO DID NOT FISH	0.0%	89.9%	86.2%	95.0%	87.5%	89.3%
TOTAL NUMBER WHO DID FISH	0	31	22	2	1	56
% WHO DID FISH	0.0%	7.3%	06.6%	1.4%	6.3%	6.1%

138

RESPONSE RESULTS OF THE RECREATIONAL BILLFISH SURVEY
COAST GUARD

SURVEY ELEMENTS	BOAT SIZE (IN FEET)					
	18-19	20-25	26-34	35-45	46-65	TOTALS
SAMPLE SELECTION						
POPULATION SIZE	0	490	16971	11790	4179	33430
SAMPLING FRACTION	1/00	1/18	1/06	1/06	1/18	
SAMPLE SELECTED	0	28	2828	1965	232	5053

****

MAIL RESPONSE INFORMATION						
TOTAL NUMBER OF MAIL RESPONDENTS	0	17	1804	1102	120	3043
% RESPONSE	0.0%	60.7%	63.8%	56.1%	51.7%	60.2%
% RESPONSE NONDELS REMOVED	0.0%	65.4%	73.6%	66.2%	60.3%	70.1%
NUMBER RESPONDING FIRST MAILING	0	13	1296	787	81	2177
% RESPONDING FIRST MAILING	0.0%	46.4%	45.8%	40.1%	34.9%	43.1%
NUMBER RESPONDING SECOND MAILING	0	4	508	315	39	866
% RESPONDING SECOND MAILING	0.0%	14.3%	18.0%	16.0%	16.8%	17.1%
NUMBER OF NONDELIVERABLES	0	2	376	300	33	711
% NONDELIVERABLES	0.0%	7.1%	13.3%	15.3%	14.2%	14.1%

****

PHONE SURVEY INFORMATION						
TOTAL NOT RESPONDING TO MAILINGS	0	11	1024	863	112	2010
SUBSAMPLING FRACTION	1/00	1/00	1/03	1/03	1/03	
SUBSAMPLE SELECTED	0	0	352	296	38	686
NUMBER COMPLETED INTERVIEWS	0	0	130	108	7	245
% COMPLETED INTERVIEWS	0.0%	0.0%	36.9%	36.5%	18.4%	35.7%

****

TOTAL RESPONSE INFORMATION						
NUMBER OF RESPONDENTS	0	17	1934	1210	127	3288
% RESPONSE	0.0%	60.7%	68.4%	61.6%	54.7%	65.1%
NUMBER OF NONRESPONDENTS	0	11	894	755	105	1765
TOTAL NUMBER WHO DID NOT FISH	0	16	1740	1015	99	2870
% WHO DID NOT FISH	0.0%	94.1%	90.0%	83.9%	78.0%	87.3%
TOTAL NUMBER WHO DID FISH	0	1	134	154	14	303
% WHO DID FISH	0.0%	5.9%	06.9%	12.7%	11.0%	9.2%

139

RESPONSE RESULTS OF THE RECREATIONAL BILLFISH SURVEY
CONNECTICUT

SURVEY ELEMENTS	BOAT SIZE (IN FEET)					
	18-19	20-25	26-34	35-45	46-65	TOTALS
SAMPLE SELECTION						
POPULATION SIZE	0	10764	4786	787	37	16374
SAMPLING FRACTION	1/00	1/12	1/04	1/04	1/12	
SAMPLE SELECTED	0	897	1197	197	3	2294

****

	18-19	20-25	26-34	35-45	46-65	TOTALS
MAIL RESPONSE INFORMATION						
TOTAL NUMBER OF MAIL RESPONDENTS	0	517	657	103	1	1278
% RESPONSE	0.0%	57.6%	54.9%	52.3%	33.3%	55.7%
% RESPONSE NONDELS REMOVED	0.0%	63.4%	62.8%	64.0%	100.0%	63.2%
NUMBER RESPONDING FIRST MAILING	0	313	423	60	0	796
% RESPONDING FIRST MAILING	0.0%	34.9%	35.3%	30.5%	0.0%	34.7%
NUMBER RESPONDING SECOND MAILING	0	204	234	43	1	482
% RESPONDING SECOND MAILING	0.0%	22.7%	19.5%	21.8%	33.3%	21.0%
NUMBER OF NONDELIVERABLES	0	82	151	36	2	271
% NONDELIVERABLES	0.0%	9.1%	12.6%	18.3%	66.7%	11.8%

****

	18-19	20-25	26-34	35-45	46-65	TOTALS
PHONE SURVEY INFORMATION						
TOTAL NOT RESPONDING TO MAILINGS	0	380	540	94	2	1016
SUBSAMPLING FRACTION	1/00	1/09	1/03	1/03	1/03	
SUBSAMPLE SELECTED	0	43	184	34	1	262
NUMBER COMPLETED INTERVIEWS	0	20	86	13	0	119
% COMPLETED INTERVIEWS	0.0%	46.5%	46.7%	38.2%	0.0%	45.4%

****

	18-19	20-25	26-34	35-45	46-65	TOTALS
TOTAL RESPONSE INFORMATION						
NUMBER OF RESPONDENTS	0	537	743	116	1	1397
% RESPONSE	0.0%	59.9%	62.1%	58.9%	33.3%	60.9%
NUMBER OF NONRESPONDENTS	0	360	454	81	2	897
TOTAL NUMBER WHO DID NOT FISH	0	503	669	100	0	1272
% WHO DID NOT FISH	0.0%	93.7%	90.0%	86.2%	0.0%	91.1%
TOTAL NUMBER WHO DID FISH	0	16	26	5	0	47
% WHO DID FISH	0.0%	3.0%	03.5%	4.3%	0.0%	3.4%

RESPONSE RESULTS OF THE RECREATIONAL BILLFISH SURVEY
DELAWARE

| SURVEY ELEMENTS | BOAT SIZE (IN FEET) | | | | | |
	18-19	20-25	26-34	35-45	46-65	TOTALS
SAMPLE SELECTION						
POPULATION SIZE	8230	0	0	0	0	8230
SAMPLING FRACTION	1/10	1/00	1/00	1/00	1/00	
SAMPLE SELECTED	823	0	0	0	0	823

****

MAIL RESPONSE INFORMATION						
TOTAL NUMBER OF MAIL RESPONDENTS	478	0	0	0	0	478
% RESPONSE	58.1%	0.0%	00.0%	0.0%	0.0%	58.1%
% RESPONSE NONDELS REMOVED	64.7%	0.0%	00.0%	0.0%	0.0%	64.7%
NUMBER RESPONDING FIRST MAILING	327	0	0	0	0	327
% RESPONDING FIRST MAILING	39.7%	0.0%	00.0%	0.0%	0.0%	39.7%
NUMBER RESPONDING SECOND MAILING	151	0	0	0	0	151
% RESPONDING SECOND MAILING	18.3%	0.0%	00.0%	0.0%	0.0%	18.3%
NUMBER OF NONDELIVERABLES	84	0	0	0	0	84
% NONDELIVERABLES	10.2%	0.0%	00.0%	0.0%	0.0%	10.2%

****

PHONE SURVEY INFORMATION						
TOTAL NOT RESPONDING TO MAILINGS	345	0	0	0	0	345
SUBSAMPLING FRACTION	1/10	1/00	1/00	1/00	1/00	
SUBSAMPLE SELECTED	35	0	0	0	0	35
NUMBER COMPLETED INTERVIEWS	10	0	0	0	0	10
% COMPLETED INTERVIEWS	28.6%	0.0%	00.0%	0.0%	0.0%	28.6%

****

TOTAL RESPONSE INFORMATION						
NUMBER OF RESPONDENTS	488	0	0	0	0	488
% RESPONSE	59.3%	0.0%	00.0%	0.0%	0.0%	59.3%
NUMBER OF NONRESPONDENTS	335	0	0	0	0	335
TOTAL NUMBER WHO DID NOT FISH	443	0	0	0	0	443
% WHO DID NOT FISH	90.8%	0.0%	00.0%	0.0%	0.0%	90.8%
TOTAL NUMBER WHO DID FISH	41	0	0	0	0	41
% WHO DID FISH	8.4%	0.0%	00.0%	0.0%	0.0%	8.4%

RESPONSE RESULTS OF THE RECREATIONAL BILLFISH SURVEY
FLORIDA EAST COAST

| SURVEY ELEMENTS | BOAT SIZE (IN FEET) | | | | | |
	18-19	20-25	26-34	35-45	46-65	TOTALS
SAMPLE SELECTION						
POPULATION SIZE	18658	21438	4956	1723	311	47086
SAMPLING FRACTION	1/09	1/09	1/03	1/03	1/09	
SAMPLE SELECTED	2073	2382	1652	574	35	6716
MAIL RESPONSE INFORMATION						
TOTAL NUMBER OF MAIL RESPONDENTS	768	998	725	260	12	2763
% RESPONSE	37.0%	41.9%	43.9%	45.3%	34.3%	41.1%
% RESPONSE NONDELS REMOVED	55.5%	60.7%	61.4%	60.9%	46.2%	59.3%
NUMBER RESPONDING FIRST MAILING	461	604	482	157	8	1712
% RESPONDING FIRST MAILING	22.2%	25.4%	29.2%	27.4%	22.9%	25.5%
NUMBER RESPONDING SECOND MAILING	307	394	243	103	4	1051
% RESPONDING SECOND MAILING	14.8%	16.5%	14.7%	17.9%	11.4%	15.6%
NUMBER OF NONDELIVERABLES	688	739	472	147	9	2055
% NONDELIVERABLES	33.2%	31.0%	28.6%	25.6%	25.7%	30.6%
PHONE SURVEY INFORMATION						
TOTAL NOT RESPONDING TO MAILINGS	1305	1384	927	314	23	3953
SUBSAMPLING FRACTION	1/06	1/05	1/02	1/02	1/03	
SUBSAMPLE SELECTED	218	274	461	158	8	1119
NUMBER COMPLETED INTERVIEWS	71	93	146	49	5	364
% COMPLETED INTERVIEWS	32.6%	33.9%	31.7%	31.0%	62.5%	32.5%
TOTAL RESPONSE INFORMATION						
NUMBER OF RESPONDENTS	839	1091	871	309	17	3127
% RESPONSE	40.5%	45.8%	52.7%	53.8%	48.6%	46.6%
NUMBER OF NONRESPONDENTS	1234	1291	781	265	18	3589
TOTAL NUMBER WHO DID NOT FISH	638	769	569	212	9	2197
% WHO DID NOT FISH	76.0%	70.5%	65.3%	68.6%	52.9%	70.3%
TOTAL NUMBER WHO DID FISH	84	159	144	42	2	431
% WHO DID FISH	10.0%	14.6%	16.5%	13.6%	11.8%	13.8%

RESPONSE RESULTS OF THE RECREATIONAL BILLFISH SURVEY
FLORIDA GULF COAST

SURVEY ELEMENTS	BOAT SIZE (IN FEET)					
	18-19	20-25	26-34	35-45	46-65	TOTALS
SAMPLE SELECTION						
POPULATION SIZE	14617	14282	2621	765	120	32405
SAMPLING FRACTION	1/09	1/09	1/03	1/03	1/09	
SAMPLE SELECTED	1624	1587	874	255	13	4353

MAIL RESPONSE INFORMATION						
TOTAL NUMBER OF MAIL RESPONDENTS	725	783	433	127	4	2072
% RESPONSE	44.6%	49.3%	49.5%	49.8%	30.8%	47.6%
% RESPONSE NONDELS REMOVED	62.5%	65.1%	65.5%	62.0%	40.0%	64.0%
NUMBER RESPONDING FIRST MAILING	471	510	268	82	3	1334
% RESPONDING FIRST MAILING	29.0%	32.1%	30.7%	32.2%	23.1%	30.6%
NUMBER RESPONDING SECOND MAILING	254	273	165	45	1	738
% RESPONDING SECOND MAILING	15.6%	17.2%	18.9%	17.6%	7.7%	17.0%
NUMBER OF NONDELIVERABLES	464	385	213	50	3	1115
% NONDELIVERABLES	28.6%	24.3%	24.4%	19.6%	23.1%	25.6%

PHONE SURVEY INFORMATION						
TOTAL NOT RESPONDING TO MAILINGS	899	804	441	128	9	2281
SUBSAMPLING FRACTION	1/06	1/06	1/02	1/02	1/03	
SUBSAMPLE SELECTED	150	135	221	65	3	574
NUMBER COMPLETED INTERVIEWS	63	69	75	27	0	234
% COMPLETED INTERVIEWS	42.0%	51.1%	33.9%	41.5%	0.0%	40.8%

TOTAL RESPONSE INFORMATION						
NUMBER OF RESPONDENTS	788	852	508	154	4	2306
% RESPONSE	48.5%	53.7%	58.1%	60.4%	30.8%	53.0%
NUMBER OF NONRESPONDENTS	836	735	366	101	9	2047
TOTAL NUMBER WHO DID NOT FISH	636	693	402	124	4	1859
% WHO DID NOT FISH	80.7%	81.3%	79.1%	80.5%	100.0%	80.6%
TOTAL NUMBER WHO DID FISH	36	43	28	8	0	115
% WHO DID FISH	4.6%	5.0%	05.5%	5.2%	0.0%	5.0%

RESPONSE RESULTS OF THE RECREATIONAL BILLFISH SURVEY
GEORGIA

SURVEY ELEMENTS	BOAT SIZE (IN FEET)					
	18-19	20-25	26-34	35-45	46-65	TOTALS
SAMPLE SELECTION						
POPULATION SIZE	0	4164	945	561	222	5892
SAMPLING FRACTION	1/00	1/09	1/03	1/03	1/09	
SAMPLE SELECTED	0	463	315	187	25	990
MAIL RESPONSE INFORMATION						
TOTAL NUMBER OF MAIL RESPONDENTS	0	280	193	102	14	589
% RESPONSE	0.0%	60.5%	61.3%	54.5%	56.0%	59.5%
% RESPONSE NONDELS REMOVED	0.0%	64.1%	66.3%	60.7%	63.6%	64.2%
NUMBER RESPONDING FIRST MAILING	0	165	118	59	8	350
% RESPONDING FIRST MAILING	0.0%	35.6%	37.5%	31.6%	32.0%	35.4%
NUMBER RESPONDING SECOND MAILING	0	115	75	43	6	239
% RESPONDING SECOND MAILING	0.0%	24.8%	23.8%	23.0%	24.0%	24.1%
NUMBER OF NONDELIVERABLES	0	26	24	19	3	72
% NONDELIVERABLES	0.0%	5.6%	07.6%	10.2%	12.0%	7.3%
PHONE SURVEY INFORMATION						
TOTAL NOT RESPONDING TO MAILINGS	0	183	122	85	11	401
SUBSAMPLING FRACTION	1/00	1/06	1/02	1/02	1/03	
SUBSAMPLE SELECTED	0	31	63	43	4	141
NUMBER COMPLETED INTERVIEWS	0	19	32	16	1	68
% COMPLETED INTERVIEWS	0.0%	61.3%	50.8%	37.2%	25.0%	48.2%
TOTAL RESPONSE INFORMATION						
NUMBER OF RESPONDENTS	0	299	225	118	15	657
% RESPONSE	0.0%	64.6%	71.4%	63.1%	60.0%	66.4%
NUMBER OF NONRESPONDENTS	0	164	90	69	10	333
TOTAL NUMBER WHO DID NOT FISH	0	273	206	112	14	605
% WHO DID NOT FISH	0.0%	91.3%	91.6%	94.9%	93.3%	92.1%
TOTAL NUMBER WHO DID FISH	0	16	7	1	0	24
% WHO DID FISH	0.0%	5.4%	03.1%	0.8%	0.0%	3.7%

RESPONSE RESULTS OF THE RECREATIONAL BILLFISH SURVEY
LOUISIANA

SURVEY ELEMENTS	BOAT SIZE (IN FEET)					
	18-19	20-25	26-34	35-45	46-65	TOTALS
SAMPLE SELECTION						
POPULATION SIZE	0	13542	5080	1599	296	20517
SAMPLING FRACTION	1/00	1/12	1/04	1/04	1/12	
SAMPLE SELECTED	0	1128	1270	400	25	2823

****

MAIL RESPONSE INFORMATION						
TOTAL NUMBER OF MAIL RESPONDENTS	0	637	677	196	15	1525
% RESPONSE	0.0%	56.5%	53.3%	49.0%	60.0%	54.0%
% RESPONSE NONDELS REMOVED	0.0%	59.5%	56.0%	50.8%	60.0%	56.7%
NUMBER RESPONDING FIRST MAILING	0	375	382	129	12	898
% RESPONDING FIRST MAILING	0.0%	33.2%	30.1%	32.3%	48.0%	31.8%
NUMBER RESPONDING SECOND MAILING	0	262	295	67	3	627
% RESPONDING SECOND MAILING	0.0%	23.2%	23.2%	16.8%	12.0%	22.2%
NUMBER OF NONDELIVERABLES	0	57	61	14	0	132
% NONDELIVERABLES	0.0%	5.1%	04.8%	3.5%	0.0%	4.7%

****

PHONE SURVEY INFORMATION						
TOTAL NOT RESPONDING TO MAILINGS	0	491	593	204	10	1298
SUBSAMPLING FRACTION	1/00	1/09	1/03	1/03	1/03	
SUBSAMPLE SELECTED	0	55	201	69	4	329
NUMBER COMPLETED INTERVIEWS	0	29	104	33	2	168
% COMPLETED INTERVIEWS	0.0%	52.7%	51.7%	47.8%	50.0%	51.1%

****

TOTAL RESPONSE INFORMATION						
NUMBER OF RESPONDENTS	0	666	781	229	17	1693
% RESPONSE	0.0%	59.0%	61.5%	57.3%	68.0%	60.0%
NUMBER OF NONRESPONDENTS	0	462	489	171	8	1130
TOTAL NUMBER WHO DID NOT FISH	0	612	717	214	16	1559
% WHO DID NOT FISH	0.0%	91.9%	91.8%	93.4%	94.1%	92.1%
TOTAL NUMBER WHO DID FISH	0	39	38	7	1	85
% WHO DID FISH	0.0%	5.9%	04.9%	3.1%	5.9%	5.0%

RESPONSE RESULTS OF THE RECREATIONAL BILLFISH SURVEY
MASSACHUSETTS

SURVEY ELEMENTS	BOAT SIZE (IN FEET)					
	18-19	20-25	26-34	35-45	46-65	TOTALS
SAMPLE SELECTION						
POPULATION SIZE	0	14994	6346	1264	113	22717
SAMPLING FRACTION	1/00	1/12	1/04	1/04	1/12	
SAMPLE SELECTED	0	1249	1587	316	10	3162

****

MAIL RESPONSE INFORMATION						
TOTAL NUMBER OF MAIL RESPONDENTS	0	725	931	176	2	1834
% RESPONSE	0.0%	58.0%	58.7%	55.7%	20.0%	58.0%
% RESPONSE NONDELS REMOVED	0.0%	64.6%	64.8%	63.1%	20.0%	64.4%
NUMBER RESPONDING FIRST MAILING	0	472	653	122	2	1249
% RESPONDING FIRST MAILING	0.0%	37.8%	41.1%	38.6%	20.0%	39.5%
NUMBER RESPONDING SECOND MAILING	0	253	278	54	0	585
% RESPONDING SECOND MAILING	0.0%	20.3%	17.5%	17.1%	0.0%	18.5%
NUMBER OF NONDELIVERABLES	0	127	150	37	0	314
% NONDELIVERABLES	0.0%	10.2%	09.5%	11.7%	0.0%	9.9%

****

PHONE SURVEY INFORMATION						
TOTAL NOT RESPONDING TO MAILINGS	0	524	656	140	8	1328
SUBSAMPLING FRACTION	1/00	1/09	1/03	1/03	1/03	
SUBSAMPLE SELECTED	0	60	222	48	3	333
NUMBER COMPLETED INTERVIEWS	0	29	105	21	1	156
% COMPLETED INTERVIEWS	0.0%	48.3%	47.3%	43.8%	33.3%	46.8%

****

TOTAL RESPONSE INFORMATION						
NUMBER OF RESPONDENTS	0	754	1036	197	3	1990
% RESPONSE	0.0%	60.4%	65.3%	62.3%	30.0%	62.9%
NUMBER OF NONRESPONDENTS	0	495	551	119	7	1172
TOTAL NUMBER WHO DID NOT FISH	0	699	967	178	2	1846
% WHO DID NOT FISH	0.0%	92.7%	93.3%	90.4%	66.7%	92.8%
TOTAL NUMBER WHO DID FISH	0	17	29	9	1	56
% WHO DID FISH	0.0%	2.3%	02.8%	4.6%	33.3%	2.8%

RESPONSE RESULTS OF THE RECREATIONAL BILLFISH SURVEY
MARYLAND

| SURVEY ELEMENTS | BOAT SIZE (IN FEET) | | | | | |
	18-19	20-25	26-34	35-45	46-65	TOTALS
SAMPLE SELECTION						
POPULATION SIZE	0	14103	8925	2171	105	25304
SAMPLING FRACTION	1/00	1/12	1/04	1/04	1/12	
SAMPLE SELECTED	0	1175	2232	543	9	3959
*****						
MAIL RESPONSE INFORMATION						
TOTAL NUMBER OF MAIL RESPONDENTS	0	800	1524	362	5	2691
% RESPONSE	0.0%	68.1%	68.3%	66.7%	55.6%	68.0%
% RESPONSE NONDELS REMOVED	0.0%	69.7%	70.0%	68.2%	62.5%	69.7%
NUMBER RESPONDING FIRST MAILING	0	567	1033	243	5	1848
% RESPONDING FIRST MAILING	0.0%	48.3%	46.3%	44.8%	55.6%	46.7%
NUMBER RESPONDING SECOND MAILING	0	233	491	119	0	843
% RESPONDING SECOND MAILING	0.0%	19.8%	22.0%	21.9%	0.0%	21.3%
NUMBER OF NONDELIVERABLES	0	28	56	12	1	97
% NONDELIVERABLES	0.0%	2.4%	02.5%	2.2%	11.1%	2.5%
*****						
PHONE SURVEY INFORMATION						
TOTAL NOT RESPONDING TO MAILINGS	0	375	708	181	4	1268
SUBSAMPLING FRACTION	1/00	1/09	1/03	1/03	1/03	
SUBSAMPLE SELECTED	0	43	245	63	1	352
NUMBER COMPLETED INTERVIEWS	0	20	124	27	0	171
% COMPLETED INTERVIEWS	0.0%	46.5%	50.6%	42.9%	0.0%	48.6%
*****						
TOTAL RESPONSE INFORMATION						
NUMBER OF RESPONDENTS	0	820	1648	389	5	2862
% RESPONSE	0.0%	69.8%	73.8%	71.6%	55.6%	72.3%
NUMBER OF NONRESPONDENTS	0	355	584	154	4	1097
TOTAL NUMBER WHO DID NOT FISH	0	790	1611	373	5	2779
% WHO DID NOT FISH	0.0%	96.3%	97.8%	95.9%	100.0%	97.1%
TOTAL NUMBER WHO DID FISH	0	16	23	8	0	47
% WHO DID FISH	0.0%	2.0%	01.4%	2.1%	0.0%	1.6%

RESPONSE RESULTS OF THE RECREATIONAL BILLFISH SURVEY
MISSISSIPPI

SURVEY ELEMENTS	BOAT SIZE (IN FEET)					TOTALS
	18-19	20-25	26-34	35-45	46-65	
SAMPLE SELECTION						
POPULATION SIZE	0	3149	1018	269	62	4498
SAMPLING FRACTION	1/00	1/12	1/04	1/04	1/12	
SAMPLE SELECTED	0	262	254	67	5	588

MAIL RESPONSE INFORMATION						
TOTAL NUMBER OF MAIL RESPONDENTS	0	150	126	37	2	315
% RESPONSE	0.0%	57.3%	49.6%	55.2%	40.0%	53.6%
% RESPONSE NONDELS REMOVED	0.0%	62.0%	52.9%	58.7%	40.0%	57.5%
NUMBER RESPONDING FIRST MAILING	0	98	73	26	2	199
% RESPONDING FIRST MAILING	0.0%	37.4%	28.7%	38.8%	40.0%	33.8%
NUMBER RESPONDING SECOND MAILING	0	52	53	11	0	116
% RESPONDING SECOND MAILING	0.0%	19.8%	20.9%	16.4%	0.0%	19.7%
NUMBER OF NONDELIVERABLES	0	20	16	4	0	40
% NONDELIVERABLES	0.0%	7.6%	06.3%	6.0%	0.0%	6.8%

PHONE SURVEY INFORMATION						
TOTAL NOT RESPONDING TO MAILINGS	0	112	128	30	3	273
SUBSAMPLING FRACTION	1/00	1/09	1/03	1/03	1/03	
SUBSAMPLE SELECTED	0	13	42	10	1	66
NUMBER COMPLETED INTERVIEWS	0	7	23	5	1	36
% COMPLETED INTERVIEWS	0.0%	53.8%	54.8%	50.0%	100.0%	54.5%

TOTAL RESPONSE INFORMATION						
NUMBER OF RESPONDENTS	0	157	149	42	3	351
% RESPONSE	0.0%	59.9%	58.7%	62.7%	60.0%	59.7%
NUMBER OF NONRESPONDENTS	0	105	105	25	2	237
TOTAL NUMBER WHO DID NOT FISH	0	143	134	39	2	318
% WHO DID NOT FISH	0.0%	91.1%	89.9%	92.9%	66.7%	90.6%
TOTAL NUMBER WHO DID FISH	0	11	7	2	0	20
% WHO DID FISH	0.0%	7.0%	04.7%	4.8%	0.0%	5.7%

148

RESPONSE RESULTS OF THE RECREATIONAL BILLFISH SURVEY
NORTH CAROLINA

SURVEY ELEMENTS	BOAT SIZE (IN FEET)					
	18-19	20-25	26-34	35-45	46-65	TOTALS
SAMPLE SELECTION						
POPULATION SIZE	0	11259	2459	528	28	14274
SAMPLING FRACTION	1/00	1/09	1/03	1/03	1/09	
SAMPLE SELECTED	0	1251	820	176	3	2250

****

MAIL RESPONSE INFORMATION						
TOTAL NUMBER OF MAIL RESPONDENTS	0	777	531	121	1	1430
% RESPONSE	0.0%	62.1%	64.8%	68.8%	33.3%	63.6%
% RESPONSE NONDELS REMOVED	0.0%	63.8%	66.4%	69.5%	50.0%	65.2%
NUMBER RESPONDING FIRST MAILING	0	491	358	73	1	923
% RESPONDING FIRST MAILING	0.0%	39.2%	43.7%	41.5%	33.3%	41.0%
NUMBER RESPONDING SECOND MAILING	0	286	173	48	0	507
% RESPONDING SECOND MAILING	0.0%	22.9%	21.1%	27.3%	0.0%	22.5%
NUMBER OF NONDELIVERABLES	0	33	20	2	1	56
% NONDELIVERABLES	0.0%	2.6%	02.4%	1.1%	33.3%	2.5%

****

PHONE SURVEY INFORMATION						
TOTAL NOT RESPONDING TO MAILINGS	0	474	289	55	2	820
SUBSAMPLING FRACTION	1/00	1/06	1/02	1/02	1/03	
SUBSAMPLE SELECTED	0	81	147	29	1	258
NUMBER COMPLETED INTERVIEWS	0	50	81	18	1	150
% COMPLETED INTERVIEWS	0.0%	61.7%	55.1%	62.1%	100.0%	58.1%

****

TOTAL RESPONSE INFORMATION						
NUMBER OF RESPONDENTS	0	827	612	139	2	1580
% RESPONSE	0.0%	66.1%	74.6%	79.0%	66.7%	70.2%
NUMBER OF NONRESPONDENTS	0	424	208	37	1	670
TOTAL NUMBER WHO DID NOT FISH	0	765	555	121	2	1443
% WHO DID NOT FISH	0.0%	92.5%	90.7%	87.1%	100.0%	91.3%
TOTAL NUMBER WHO DID FISH	0	57	47	15	0	119
% WHO DID FISH	0.0%	6.9%	07.7%	10.8%	0.0%	7.5%

RESPONSE RESULTS OF THE RECREATIONAL BILLFISH SURVEY
NEW HAMPSHIRE

| SURVEY ELEMENTS | BOAT SIZE (IN FEET) | | | | | |
	18-19	20-25	26-34	35-45	46-65	TOTALS
SAMPLE SELECTION						
POPULATION SIZE	0	699	363	103	10	1175
SAMPLING FRACTION	1/00	1/06	1/03	1/03	1/06	
SAMPLE SELECTED	0	117	121	35	1	274
**						
MAIL RESPONSE INFORMATION						
TOTAL NUMBER OF MAIL RESPONDENTS	0	76	70	15	1	162
% RESPONSE	0.0%	65.0%	57.9%	42.9%	100.0%	59.1%
% RESPONSE NONDELS REMOVED	0.0%	73.8%	68.0%	53.6%	100.0%	68.9%
NUMBER RESPONDING FIRST MAILING	0	42	47	10	1	100
% RESPONDING FIRST MAILING	0.0%	35.9%	38.8%	28.6%	100.0%	36.5%
NUMBER RESPONDING SECOND MAILING	0	34	23	5	0	62
% RESPONDING SECOND MAILING	0.0%	29.1%	19.0%	14.3%	0.0%	22.6%
NUMBER OF NONDELIVERABLES	0	14	18	7	0	39
% NONDELIVERABLES	0.0%	12.0%	14.9%	20.0%	0.0%	14.2%
**						
PHONE SURVEY INFORMATION						
TOTAL NOT RESPONDING TO MAILINGS	0	41	51	20	0	112
SUBSAMPLING FRACTION	1/00	1/09	1/03	1/03	1/03	
SUBSAMPLE SELECTED	0	5	17	7	0	29
NUMBER COMPLETED INTERVIEWS	0	1	5	2	0	8
% COMPLETED INTERVIEWS	0.0%	20.0%	29.4%	28.6%	0.0%	27.6%
**						
TOTAL RESPONSE INFORMATION						
NUMBER OF RESPONDENTS	0	77	75	17	1	170
% RESPONSE	0.0%	65.8%	62.0%	48.6%	100.0%	62.0%
NUMBER OF NONRESPONDENTS	0	40	46	18	0	104
TOTAL NUMBER WHO DID NOT FISH	0	71	71	15	1	158
% WHO DID NOT FISH	0.0%	92.2%	94.7%	88.2%	100.0%	92.9%
TOTAL NUMBER WHO DID FISH	0	1	1	1	0	3
% WHO DID FISH	0.0%	1.3%	01.3%	5.9%	0.0%	1.8%

RESPONSE RESULTS OF THE RECREATIONAL BILLFISH SURVEY
NEW JERSEY

SURVEY ELEMENTS	BOAT SIZE (IN FEET) 18-19	20-25	26-34	35-45	46-65	TOTALS
SAMPLE SELECTION						
POPULATION SIZE	0	17210	7189	790	50	25239
SAMPLING FRACTION	1/00	1/12	1/04	1/04	1/12	
SAMPLE SELECTED	0	1434	1798	197	4	3433
MAIL RESPONSE INFORMATION						
TOTAL NUMBER OF MAIL RESPONDENTS	0	837	1043	106	2	1988
% RESPONSE	0.0%	58.4%	58.0%	53.8%	50.0%	57.9%
% RESPONSE NONDELS REMOVED	0.0%	63.9%	64.2%	60.6%	50.0%	63.9%
NUMBER RESPONDING FIRST MAILING	0	532	653	69	1	1255
% RESPONDING FIRST MAILING	0.0%	37.1%	36.3%	35.0%	25.0%	36.6%
NUMBER RESPONDING SECOND MAILING	0	305	390	37	1	733
% RESPONDING SECOND MAILING	0.0%	21.3%	21.7%	18.8%	25.0%	21.4%
NUMBER OF NONDELIVERABLES	0	125	174	22	0	321
% NONDELIVERABLES	0.0%	8.7%	09.7%	11.2%	0.0%	9.4%
PHONE SURVEY INFORMATION						
TOTAL NOT RESPONDING TO MAILINGS	0	597	755	91	2	1445
SUBSAMPLING FRACTION	1/00	1/09	1/03	1/03	1/03	
SUBSAMPLE SELECTED	0	67	256	31	1	355
NUMBER COMPLETED INTERVIEWS	0	23	99	14	1	137
% COMPLETED INTERVIEWS	0.0%	34.3%	38.7%	45.2%	100.0%	38.6%
TOTAL RESPONSE INFORMATION						
NUMBER OF RESPONDENTS	0	860	1142	120	3	2125
% RESPONSE	0.0%	60.0%	63.5%	60.9%	75.0%	61.9%
NUMBER OF NONRESPONDENTS	0	574	656	77	1	1308
TOTAL NUMBER WHO DID NOT FISH	0	763	1018	96	3	1880
% WHO DID NOT FISH	0.0%	88.7%	89.1%	80.0%	100.0%	88.5%
TOTAL NUMBER WHO DID FISH	0	61	72	17	0	150
% WHO DID FISH	0.0%	7.1%	06.3%	14.2%	0.0%	7.1%

RESPONSE RESULTS OF THE RECREATIONAL BILLFISH SURVEY
NEW YORK

| SURVEY ELEMENTS | BOAT SIZE (IN FEET) | | | | | |
	18-19	20-25	26-34	35-45	46-65	TOTALS
SAMPLE SELECTION						
POPULATION SIZE	0	39800	19520	2481	210	62011
SAMPLING FRACTION	1/00	1/12	1/04	1/04	1/12	
SAMPLE SELECTED	0	3317	4880	621	18	8836

****

MAIL RESPONSE INFORMATION						
TOTAL NUMBER OF MAIL RESPONDENTS	0	1953	2858	381	7	5199
% RESPONSE	0.0%	58.9%	58.6%	61.4%	38.9%	58.8%
% RESPONSE NONDELS REMOVED	0.0%	64.8%	65.0%	69.1%	53.8%	65.2%
NUMBER RESPONDING FIRST MAILING	0	1302	1914	251	7	3474
% RESPONDING FIRST MAILING	0.0%	39.3%	39.2%	40.4%	38.9%	39.3%
NUMBER RESPONDING SECOND MAILING	0	651	944	130	0	1725
% RESPONDING SECOND MAILING	0.0%	19.6%	19.3%	20.9%	0.0%	19.5%
NUMBER OF NONDELIVERABLES	0	304	484	70	5	863
% NONDELIVERABLES	0.0%	9.2%	09.9%	11.3%	27.8%	9.8%

****

PHONE SURVEY INFORMATION						
TOTAL NOT RESPONDING TO MAILINGS	0	1364	2022	240	11	3637
SUBSAMPLING FRACTION	1/00	1/09	1/03	1/03	1/03	
SUBSAMPLE SELECTED	0	155	688	84	4	931
NUMBER COMPLETED INTERVIEWS	0	73	285	37	0	395
% COMPLETED INTERVIEWS	0.0%	47.1%	41.4%	44.0%	0.0%	42.4%

****

TOTAL RESPONSE INFORMATION						
NUMBER OF RESPONDENTS	0	2026	3143	418	7	5594
% RESPONSE	0.0%	61.1%	64.4%	67.3%	38.9%	63.3%
NUMBER OF NONRESPONDENTS	0	1291	1737	203	11	3242
TOTAL NUMBER WHO DID NOT FISH	0	1860	2849	369	7	5085
% WHO DID NOT FISH	0.0%	91.8%	90.6%	88.3%	100.0%	90.9%
TOTAL NUMBER WHO DID FISH	0	103	180	24	0	307
% WHO DID FISH	0.0%	5.1%	05.7%	5.7%	0.0%	5.5%

RESPONSE RESULTS OF THE RECREATIONAL BILLFISH SURVEY
PUERTO RICO

SURVEY ELEMENTS	BOAT SIZE (IN FEET)					
	18-19	20-25	26-34	35-45	46-65	TOTALS
SAMPLE SELECTION						
POPULATION SIZE	1910	0	0	0	0	1910
SAMPLING FRACTION	1/10	1/00	1/00	1/00	1/00	
SAMPLE SELECTED	191	0	0	0	0	191
***						
MAIL RESPONSE INFORMATION						
TOTAL NUMBER OF MAIL RESPONDENTS	64	0	0	0	0	64
% RESPONSE	33.5%	0.0%	00.0%	0.0%	0.0%	33.5%
% RESPONSE NONDELS REMOVED	38.1%	0.0%	00.0%	0.0%	0.0%	38.1%
NUMBER RESPONDING FIRST MAILING	42	0	0	0	0	42
% RESPONDING FIRST MAILING	22.0%	0.0%	00.0%	0.0%	0.0%	22.0%
NUMBER RESPONDING SECOND MAILING	22	0	0	0	0	22
% RESPONDING SECOND MAILING	11.5%	0.0%	00.0%	0.0%	0.0%	11.5%
NUMBER OF NONDELIVERABLES	23	0	0	0	0	23
% NONDELIVERABLES	12.0%	0.0%	00.0%	0.0%	0.0%	12.0%
***						
PHONE SURVEY INFORMATION						
TOTAL NOT RESPONDING TO MAILINGS	127	0	0	0	0	127
SUBSAMPLING FRACTION	1/00	1/00	1/00	1/00	1/00	
SUBSAMPLE SELECTED	0	0	0	0	0	0
NUMBER COMPLETED INTERVIEWS	0	0	0	0	0	0
% COMPLETED INTERVIEWS	0.0%	0.0%	00.0%	0.0%	0.0%	0.0%
***						
TOTAL RESPONSE INFORMATION						
NUMBER OF RESPONDENTS	64	0	0	0	0	64
% RESPONSE	33.5%	0.0%	00.0%	0.0%	0.0%	33.5%
NUMBER OF NONRESPONDENTS	127	0	0	0	0	127
TOTAL NUMBER WHO DID NOT FISH	45	0	0	0	0	45
% WHO DID NOT FISH	70.3%	0.0%	00.0%	0.0%	0.0%	70.3%
TOTAL NUMBER WHO DID FISH	16	0	0	0	0	16
% WHO DID FISH	25.0%	0.0%	00.0%	0.0%	0.0%	25.0%

RESPONSE RESULTS OF THE RECREATIONAL BILLFISH SURVEY
RHODE ISLAND

SURVEY ELEMENTS	BOAT SIZE (IN FEET)					
	18-19	20-25	26-34	35-45	46-65	TOTALS
SAMPLE SELECTION						
POPULATION SIZF	0	3065	1633	333	14	5045
SAMPLING FRACTION	1/00	1/12	1/04	1/04	1/12	
SAMPLE SELECTED	0	255	409	84	1	749

****

MAIL RESPONSE INFORMATION						
TOTAL NUMBER OF MAIL RESPONDENTS	0	153	262	51	0	466
% RESPONSE	0.0%	60.0%	64.1%	60.7%	0.0%	62.2%
% RESPONSE NONDELS REMOVED	0.0%	62.4%	68.1%	63.0%	0.0%	65.4%
NUMBER RESPONDING FIRST MAILING	0	94	164	32	0	290
% RESPONDING FIRST MAILING	0.0%	36.9%	40.1%	38.1%	0.0%	38.7%
NUMBER RESPONDING SECOND MAILING	0	59	98	19	0	176
% RESPONDING SECOND MAILING	0.0%	23.1%	24.0%	22.6%	0.0%	23.5%
NUMBER OF NONDELIVERABLES	0	10	24	3	0	37
% NONDELIVERABLES	0.0%	3.9%	05.9%	3.6%	0.0%	4.9%

****

PHONE SURVEY INFORMATION						
TOTAL NOT RESPONDING TO MAILINGS	0	102	147	33	1	283
SUBSAMPLING FRACTION	1/00	1/09	1/03	1/03	1/03	
SUBSAMPLE SELECTED	0	12	50	12	1	75
NUMBER COMPLETED INTERVIEWS	0	3	29	4	1	37
% COMPLETED INTERVIEWS	0.0%	25.0%	58.0%	33.3%	100.0%	49.3%

****

TOTAL RESPONSE INFORMATION						
NUMBER OF RESPONDENTS	0	156	291	55	1	503
% RESPONSE	0.0%	61.2%	71.1%	65.5%	100.0%	67.2%
NUMBER OF NONRESPONDENTS	0	99	118	29	0	246
TOTAL NUMBER WHO DID NOT FISH	0	145	263	48	1	457
% WHO DID NOT FISH	0.0%	92.9%	90.4%	87.3%	100.0%	90.9%
TOTAL NUMBER WHO DID FISH	0	6	17	2	0	25
% WHO DID FISH	0.0%	3.8%	05.8%	3.6%	0.0%	5.0%

154

RESPONSE RESULTS OF THE RECREATIONAL BILLFISH SURVEY
SOUTH CAROLINA

| SURVEY ELEMENTS | BOAT SIZE (IN FEET) | | | | | |
	18-19	20-25	26-34	35-45	46-65	TOTALS
SAMPLE SELECTION						
POPULATION SIZE	0	5319	1868	365	74	7626
SAMPLING FRACTION	1/00	1/12	1/04	1/04	1/12	
SAMPLE SELECTED	0	443	467	91	6	1007

****

MAIL RESPONSE INFORMATION						
TOTAL NUMBER OF MAIL RESPONDENTS	0	275	314	59	2	650
% RESPONSE	0.0%	62.1%	67.2%	64.8%	33.3%	64.5%
% RESPONSE NONDELS REMOVED	0.0%	65.2%	70.4%	70.2%	40.0%	67.9%
NUMBER RESPONDING FIRST MAILING	0	160	202	44	2	408
% RESPONDING FIRST MAILING	0.0%	36.1%	43.3%	48.4%	33.3%	40.5%
NUMBER RESPONDING SECOND MAILING	0	115	112	15	0	242
% RESPONDING SECOND MAILING	0.0%	26.0%	24.0%	16.5%	0.0%	24.0%
NUMBER OF NONDELIVERABLES	0	21	21	7	1	50
% NONDELIVERABLES	0.0%	4.7%	04.5%	7.7%	16.7%	5.0%

****

PHONE SURVEY INFORMATION						
TOTAL NOT RESPONDING TO MAILINGS	0	168	153	32	4	357
SUBSAMPLING FRACTION	1/00	1/06	1/02	1/02	1/03	
SUBSAMPLE SELECTED	0	29	80	16	2	127
NUMBER COMPLETED INTERVIEWS	0	14	42	6	1	63
% COMPLETED INTERVIEWS	0.0%	48.3%	52.5%	37.5%	50.0%	49.6%

****

TOTAL RESPONSE INFORMATION						
NUMBER OF RESPONDENTS	0	289	356	65	3	713
% RESPONSE	0.0%	65.2%	76.2%	71.4%	50.0%	70.8%
NUMBER OF NONRESPONDENTS	0	154	111	26	3	294
TOTAL NUMBER WHO DID NOT FISH	0	262	320	61	3	646
% WHO DID NOT FISH	0.0%	90.7%	89.9%	93.8%	100.0%	90.6%
TOTAL NUMBER WHO DID FISH	0	23	25	2	0	50
% WHO DID FISH	0.0%	8.0%	07.0%	3.1%	0.0%	7.0%

155

RESPONSE RESULTS OF THE RECREATIONAL BILLFISH SURVEY
TEXAS

| SURVEY ELEMENTS | BOAT SIZE (IN FEET) | | | | | |
	18-19	20-25	26-34	35-45	46-65	TOTALS
SAMPLE SELECTION						
POPULATION SIZE	0	22798	4602	1204	204	28808
SAMPLING FRACTION	1/00	1/09	1/03	1/03	1/09	
SAMPLE SELECTED	0	2533	1534	402	22	4491

MAIL RESPONSE INFORMATION						
TOTAL NUMBER OF MAIL RESPONDENTS	0	1586	924	245	14	2769
% RESPONSE	0.0%	62.6%	60.2%	60.9%	63.6%	61.7%
% RESPONSE NONDELS REMOVED	0.0%	66.3%	63.3%	63.3%	66.7%	65.0%
NUMBER RESPONDING FIRST MAILING	0	1020	601	159	8	1788
% RESPONDING FIRST MAILING	0.0%	40.3%	39.2%	39.6%	36.4%	39.8%
NUMBER RESPONDING SECOND MAILING	0	566	323	86	6	981
% RESPONDING SECOND MAILING	0.0%	22.3%	21.1%	21.4%	27.3%	21.8%
NUMBER OF NONDELIVERABLES	0	141	74	15	1	231
% NONDELIVERABLES	0.0%	5.6%	04.8%	3.7%	4.5%	5.1%

PHONE SURVEY INFORMATION						
TOTAL NOT RESPONDING TO MAILINGS	0	947	610	157	8	1722
SUBSAMPLING FRACTION	1/00	1/06	1/02	1/02	1/03	
SUBSAMPLE SELECTED	0	162	315	81	3	561
NUMBER COMPLETED INTERVIEWS	0	88	146	40	1	275
% COMPLETED INTERVIEWS	0.0%	54.3%	46.3%	49.4%	33.3%	49.0%

TOTAL RESPONSE INFORMATION						
NUMBER OF RESPONDENTS	0	1674	1070	285	15	3044
% RESPONSE	0.0%	66.1%	69.8%	70.9%	68.2%	67.8%
NUMBER OF NONRESPONDENTS	0	859	464	117	7	1447
TOTAL NUMBER WHO DID NOT FISH	0	1525	973	262	13	2773
% WHO DID NOT FISH	0.0%	91.1%	90.9%	91.9%	86.7%	91.1%
TOTAL NUMBER WHO DID FISH	0	129	76	14	1	220
% WHO DID FISH	0.0%	7.7%	07.1%	4.9%	6.7%	7.2%

RESPONSE RESULTS OF THE RECREATIONAL BILLFISH SURVEY
VIRGINIA

| SURVEY ELEMENTS | BOAT SIZE (IN FEET) | | | | | |
	18-19	20-25	26-34	35-45	46-65	TOTALS
SAMPLE SELECTION						
POPULATION SIZE	0	11665	3953	1196	81	16895
SAMPLING FRACTION	1/00	1/12	1/04	1/04	1/12	
SAMPLE SELECTED	0	972	989	299	6	2266
******************						
MAIL RESPONSE INFORMATION						
TOTAL NUMBER OF MAIL RESPONDENTS	0	646	659	198	3	1506
% RESPONSE	0.0%	66.5%	66.6%	66.2%	50.0%	66.5%
% RESPONSE NONDELS REMOVED	0.0%	69.9%	69.7%	68.8%	50.0%	69.6%
NUMBER RESPONDING FIRST MAILING	0	423	429	133	1	986
% RESPONDING FIRST MAILING	0.0%	43.5%	43.4%	44.5%	16.7%	43.5%
NUMBER RESPONDING SECOND MAILING	0	223	230	65	2	520
% RESPONDING SECOND MAILING	0.0%	22.9%	23.3%	21.7%	33.3%	22.9%
NUMBER OF NONDELIVERABLES	0	48	43	11	0	102
% NONDELIVERABLES	0.0%	4.9%	04.3%	3.7%	0.0%	4.5%
******************						
PHONE SURVEY INFORMATION						
TOTAL NOT RESPONDING TO MAILINGS	0	326	330	101	3	760
SUBSAMPLING FRACTION	1/00	1/09	1/03	1/03	1/03	
SUBSAMPLE SELECTED	0	37	112	36	1	186
NUMBER COMPLETED INTERVIEWS	0	25	54	22	0	101
% COMPLETED INTERVIEWS	0.0%	67.6%	48.2%	61.1%	0.0%	54.3%
******************						
TOTAL RESPONSE INFORMATION						
NUMBER OF RESPONDENTS	0	671	713	220	3	1607
% RESPONSE	0.0%	69.0%	72.1%	73.6%	50.0%	70.9%
NUMBER OF NONRESPONDENTS	0	301	276	79	3	659
TOTAL NUMBER WHO DID NOT FISH	0	628	670	215	3	1516
% WHO DID NOT FISH	0.0%	93.6%	94.0%	97.7%	100.0%	94.3%
TOTAL NUMBER WHO DID FISH	0	34	28	4	0	66
% WHO DID FISH	0.0%	5.1%	03.9%	1.8%	0.0%	4.1%

RESPONSE RESULTS OF THE RECREATIONAL BILLFISH SURVEY
VIRGIN ISLANDS

SURVEY ELEMENTS	BOAT SIZE (IN FEET)					
	18-19	20-25	26-34	35-45	46-65	TOTALS
SAMPLE SELECTION						
POPULATION SIZE	0	370	309	177	51	907
SAMPLING FRACTION	1/00	1/03	1/02	1/02	1/03	
SAMPLE SELECTED	0	123	155	89	17	384
MAIL RESPONSE INFORMATION						
TOTAL NUMBER OF MAIL RESPONDENTS	0	36	59	35	4	134
% RESPONSE	0.0%	29.3%	38.1%	39.3%	23.5%	34.9%
% RESPONSE NONDELS REMOVED	0.0%	40.9%	55.1%	57.4%	36.4%	50.2%
NUMBER RESPONDING FIRST MAILING	0	22	39	25	2	88
% RESPONDING FIRST MAILING	0.0%	17.9%	25.2%	28.1%	11.8%	22.9%
NUMBER RESPONDING SECOND MAILING	0	14	20	10	2	46
% RESPONDING SECOND MAILING	0.0%	11.4%	12.9%	11.2%	11.8%	12.0%
NUMBER OF NONDELIVERABLES	0	35	48	28	6	117
% NONDELIVERABLES	0.0%	28.5%	31.0%	31.5%	35.3%	30.5%
PHONE SURVEY INFORMATION						
TOTAL NOT RESPONDING TO MAILINGS	0	87	96	54	13	250
SUBSAMPLING FRACTION	1/00	1/00	1/00	1/00	1/00	
SUBSAMPLE SELECTED	0	0	0	0	0	0
NUMBER COMPLETED INTERVIEWS	0	0	0	0	0	0
% COMPLETED INTERVIEWS	0.0%	0.0%	00.0%	0.0%	0.0%	0.0%
TOTAL RESPONSE INFORMATION						
NUMBER OF RESPONDENTS	0	36	59	35	4	134
% RESPONSE	0.0%	29.3%	38.1%	39.3%	23.5%	34.9%
NUMBER OF NONRESPONDENTS	0	87	96	54	13	250
TOTAL NUMBER WHO DID NOT FISH	0	34	51	30	3	118
% WHO DID NOT FISH	0.0%	94.4%	86.4%	85.7%	75.0%	88.1%
TOTAL NUMBER WHO DID FISH	0	2	7	5	1	15
% WHO DID FISH	0.0%	5.6%	11.9%	14.3%	25.0%	11.2%

APPENDIX II

DATA EXPANSION SUMMARIES

The following tables are copies of computer printouts of the summarized estimates of billfish and shark catches during the study period in the western North Atlantic Ocean. Data were summarized from the output of computer program that calculated estimates of catch and their associated variances. Data were printed by areas, boat size, and species for estimated values of caught, released, and boated fish. It is important to understand the format and codes used in the tables. The same area and boat size codes are used as in the text. They are:

Fishing Areas

V = Virginia and Northward

N = North Carolina to Florida

F = Florida East Coast and Keys

G = Gulf of Mexico

P = Puerto Rico and U.S. Virgin Islands

O = Other Waters

TOT = Total all areas combined

Boat Size Classes

1 = 18-19 feet

2 = 20-25 feet

3 = 26-34 feet

4 = 35-45 feet

5 = 46-65 feet

6 = No size class available, i.e., Puerto Rico and Delaware boats combined.

Data in the tables are presented in groups of 6 lines (rows). Each line contains information on either a billfish species or sharks, i.e., first line = blue marlin, second line = white marlin, third line = sailfish, fourth line = spearfish, fifth line = swordfish, sixth line = sharks.

The columns of data are grouped into three major groups: caught, released, and boated. Within each of these groups are four columns of data:

1. SAMPLE = The number of fish reported by respondents.

2.   T-HAT = The number of fish expanded back to the population based on the expansion formula.

3.   VARIANCE = The calculated variances of the point estimate T-HAT value.

4.   STD ERR = One standard error, i.e., the square root of the variances.

The first page of the table presents totals by area fished and total for the entire study area. The other six pages present data by boat size class for each of the areas identified in this survey.

It is possible to summarize data for any of the species of fish by summing appropriate values of T-HAT for the species and strata desired. The standard error associated with the summarized data can be calculated by summarizing the individual variances of the data under consideration and finding the square root of the total. For example, if the sailfish catch by size 3 boats was desired, one would summarize sailfish catch over all areas.

T-HAT		VARIANCE
V 3 =	577	74545
N 3 =	1475	406398
F 3 =	5630	621966
G 3 =	1347	112665
P 3 =	11	25
0 3 =	272	5324
Totals	9312	1220923

The square root of the variance = 1105. Thus, the estimated catch of sailfish by 26-34 foot boats was 9312 $\pm$ 1105 (1 standard error). This type of summary can be performed on either caught, released, or boat fish estimates. Additionally, 95% confidence limits can be placed on the data by using two standard errors: i.e., 9312 $\pm$ 2210 sailfish.

Expansion Data Summaries

Area Totals

A	CAUGHT				RELEASED				BOATED			
	SAMPLE	T-HAT	VARIANCE	STD ERR	SAMPLE	T-HAT	VARIANCE	STD ERR	SAMPLE	T-HAT	VARIANCE	STD ERR
TOT	723.	6745.	648203.	805.	416.	4293.	484778.	696.	307.	2452.	71643.	268.
TOT	1435.	15649.	2975697.	1725.	912.	10862.	2068822.	1438.	523.	4787.	175892.	419.
TOT	4871.	60008.	56211836.	7497.	3533.	44310.	46467630.	6817.	1338.	15699.	3938697.	1985.
TOT	78.	467.	26287.	162.	14.	70.	708.	27.	64.	397.	23277.	153.
TOT	224.	3000.	223471.	473.	37.	656.	36343.	191.	187.	2344.	185293.	430.
TOT	17553.	230423.	485097236.	22025.	11670.	163636.	402411448.	20060.	5883.	66786.	30609243.	5533.
V	134.	1024.	28616.	169.	77.	668.	19041.	138.	57.	356.	7033.	84.
V	573.	5387.	631440.	795.	372.	3794.	478478.	692.	201.	1592.	41879.	205.
V	59.	1213.	154758.	393.	51.	845.	84009.	290.	8.	368.	34813.	187.
V	3.	20.	180.	13.	2.	8.	48.	7.	1.	12.	132.	11.
V	64.	1065.	124317.	353.	13.	90.	1851.	43.	51.	975.	122374.	350.
V	9686.	124226.	405237056.	20131.	7051.	99520.	352962508.	18787.	2635.	24705.	7772188.	2788.
N	141.	1183.	32086.	179.	70.	610.	11543.	107.	71.	573.	13878.	118.
N	355.	3891.	783353.	885.	276.	3032.	557300.	747.	79.	860.	37160.	193.
N	433.	4271.	1337741.	1157.	340.	3567.	1159159.	1077.	93.	704.	26740.	164.
N	3.	12.	108.	10.	3.	12.	108.	10.	0.	0.	0.	0.
N	11.	54.	383.	20.	1.	3.	6.	2.	10.	51.	377.	19.
N	1011.	16296.	16199050.	4025.	648.	13684.	15805754.	3976.	363.	2613.	266247.	516.
F	112.	1244.	50155.	224.	76.	988.	41265.	203.	36.	256.	3926.	63.
F	122.	1398.	58783.	242.	62.	693.	31348.	177.	60.	705.	22857.	151.
F	3529.	47419.	53756192.	7332.	2608.	35753.	44655571.	6682.	921.	11666.	3681421.	1919.
F	25.	194.	9763.	99.	8.	44.	522.	23.	17.	150.	6939.	83.
F	112.	1052.	31986.	179.	17.	276.	7418.	86.	95.	776.	22815.	151.
F	2220.	40184.	36516900.	6043.	1316.	19796.	14898061.	3860.	904.	20388.	17578524.	4193.
G	127.	1233.	51397.	227.	67.	551.	12054.	110.	60.	683.	35768.	189.
G	268.	3615.	1381035.	1175.	140.	2474.	920800.	960.	128.	1141.	61824.	249.
G	540.	5051.	715289.	846.	292.	2585.	432772.	658.	248.	2466.	156518.	396.
G	46.	231.	16146.	127.	1.	6.	30.	5.	45.	225.	16116.	127.
G	24.	702.	61006.	247.	4.	278.	27032.	164.	20.	424.	33984.	184.
G	4125.	46405.	26775337.	5174.	2280.	28309.	18464852.	4297.	1845.	18096.	4947381.	2224.
P	104.	1077.	460526.	679.	70.	812.	382232.	618.	34.	265.	7408.	86.
P	16.	111.	1521.	39.	2.	18.	288.	17.	14.	93.	1233.	35.
P	28.	173.	4164.	65.	16.	89.	2332.	48.	12.	84.	1751.	42.
P	1.	10.	90.	9.	0.	0.	0.	0.	1.	10.	90.	9.
P	8.	73.	4408.	66.	1.	3.	6.	2.	7.	70.	4402.	66.
P	89.	776.	102618.	320.	48.	423.	75280.	274.	41.	353.	15073.	123.
O	105.	984.	25423.	159.	56.	665.	18643.	137.	49.	319.	3630.	60.
O	101.	1248.	119565.	346.	60.	851.	80608.	284.	41.	397.	10939.	105.
O	282.	1880.	243692.	494.	226.	1470.	133787.	366.	56.	410.	37454.	194.
O	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
O	5.	54.	1371.	37.	1.	6.	30.	5.	4.	48.	1341.	37.
O	422.	2536.	266267.	516.	327.	1905.	204992.	453.	95.	631.	29830.	173.

SAMPLE	T-HAT	VARIANCE	STD ERR	SAMPLE	T-HAT	VARIANCE	STD ERR	SAMPLE	T-HAT	VARIANCE	STD ERR
	CAUGHT				RELEASED				BOATED		

Expansion Data for Virginia and Northward

A	S	CAUGHT				RELEASED				BOATED			
		SAMPLE	T-HAT	VARIANCE	STD ERR	SAMPLE	T-HAT	VARIANCE	STD ERR	SAMPLE	T-HAT	VARIANCE	STD ERR
V	1	1.	165.	8652.	93.	1.	165.	8652.	93.	0.	0.	0.	0.
V	1	0.	0.	0.	0.	0.	0.	0.	0.	2.	331.	34607.	186.
V	1	5.	514.	78154.	280.	3.	183.	8948.	95.	0.	0.	0.	0.
V	1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
V	1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
V	1	7.	219.	11243.	106.	5.	201.	9803.	99.	2.	18.	288.	17.
V	2	24.	294.	7762.	88.	17.	210.	5271.	73.	7.	84.	1977.	44.
V	2	160.	1959.	412270.	642.	123.	1504.	355366.	596.	37.	455.	13576.	117.
V	2	7.	72.	1548.	39.	6.	63.	1044.	32.	1.	9.	72.	8.
V	2	1.	12.	132.	11.	0.	0.	0.	0.	1.	12.	132.	11.
V	2	6.	66.	952.	31.	2.	18.	161.	13.	4.	48.	792.	28.
V	2	2145.	53306.	230117376.	15170.	1569.	43424.	202047328.	14214.	576.	9883.	4252909.	2062.
V	3	62.	323.	5671.	75.	34.	159.	2426.	49.	28.	164.	1993.	45.
V	3	204.	1718.	93421.	306.	119.	1036.	44478.	211.	85.	681.	23669.	117.
V	3	36.	577.	74545.	273.	33.	556.	73562.	271.	3.	21.	110.	10.
V	3	2.	8.	48.	7.	2.	8.	48.	7.	0.	0.	0.	0.
V	3	37.	788.	119011.	345.	5.	20.	132.	11.	32.	768.	118784.	345.
V	3	6594.	64260.	174214234.	13199.	4880.	51789.	150422530.	12265.	1714.	12471.	3313372.	1820.
V	4	43.	202.	5994.	77.	23.	114.	2513.	50.	20.	88.	2884.	54.
V	4	176.	1364.	70237.	265.	108.	1018.	53717.	232.	68.	346.	8085.	90.
V	4	11.	50.	511.	23.	9.	42.	463.	22.	2.	8.	24.	5.
V	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
V	4	17.	172.	2916.	54.	2.	12.	120.	11.	15.	160.	2798.	53.
V	4	717.	4196.	481050.	694.	459.	2726.	270003.	520.	258.	1469.	70721.	266.
V	5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
V	5	2.	36.	1221.	35.	2.	36.	1221.	35.	0.	0.	0.	0.
V	5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
V	5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
V	5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
V	5	6.	75.	2924.	54.	0.	0.	0.	0.	6.	75.	2924.	54.
V	6	4.	40.	537.	23.	2.	20.	179.	13.	2.	20.	179.	13.
V	6	31.	310.	54291.	233.	20.	200.	23696.	154.	11.	110.	6549.	81.
V	6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
V	6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
V	6	4.	40.	1438.	38.	4.	40.	1438.	38.	0.	0.	0.	0.
V	6	217.	2170.	410214.	640.	138.	1380.	212836.	461.	79.	790.	131974.	363.
V		134.	1024.	28616.	169.	77.	668.	19041.	138.	57.	356.	7033.	84.
V		573.	5387.	631440.	795.	372.	3794.	478478.	692.	201.	1592.	41879.	205.
V		59.	1213.	154758.	393.	51.	845.	84009.	290.	8.	368.	34813.	187.
V		3.	20.	180.	13.	2.	8.	48.	7.	1.	12.	132.	11.
V		64.	1065.	124317.	353.	13.	90.	1851.	43.	51.	975.	122374.	350.
V		9686.	124226.	405237056.	20131.	7051.	99520.	352962508.	18787.	2635.	24705.	7772188.	2788.

Expansion Data for North Carolina to Florida

A S		CAUGHT				RELEASED				BOATED		
	SAMPLE	T-HAT	VARIANCE	STD ERR	SAMPLE	T-HAT	VARIANCE	STD ERR	SAMPLE	T-HAT	VARIANCE	STD ERR
N 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N 1	11.	1413.	811743.	901.	11.	1413.	811743.	901.	0.	0.	0.	0.
N 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N 1	12.	1541.	966041.	983.	12.	1541.	966041.	983.	0.	0.	0.	0.
N 2	29.	306.	7967.	89.	12.	126.	2179.	47.	17.	180.	3288.	57.
N 2	55.	691.	79011.	281.	36.	484.	45858.	214.	19.	207.	6999.	84.
N 2	51.	549.	27103.	165.	30.	325.	13896.	118.	21.	224.	5418.	74.
N 2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N 2	1.	12.	132.	11.	0.	0.	0.	0.	1.	12.	132.	11.
N 2	590.	12051.	14908020.	3861.	392.	10059.	14553167.	3815.	198.	1992.	247312.	497.
N 3	81.	451.	12757.	113.	37.	201.	2972.	55.	44.	250.	8525.	92.
N 3	146.	940.	195559.	442.	113.	755.	135676.	368.	33.	185.	5619.	75.
N 3	312.	1475.	406398.	637.	257.	1221.	284790.	534.	55.	254.	12649.	112.
N 3	3.	12.	108.	10.	3.	12.	108.	10.	0.	0.	0.	0.
N 3	9.	39.	245.	16.	1.	3.	6.	2.	8.	36.	239.	15.
N 3	255.	1512.	166591.	406.	160.	1189.	152938.	391.	95.	323.	5361.	73.
N 4	31.	427.	11362.	107.	21.	283.	6392.	80.	10.	144.	2065.	45.
N 4	154.	2260.	508783.	713.	127.	1793.	375766.	613.	27.	468.	24542.	157.
N 4	58.	825.	92407.	304.	42.	609.	48730.	221.	16.	216.	8583.	93.
N 4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N 4	1.	3.	6.	2.	0.	0.	0.	0.	1.	3.	6.	2.
N 4	154.	1192.	158398.	398.	84.	895.	133608.	366.	70.	297.	13574.	117.
N 5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N 5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N 5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N 5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N 5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N 5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N 6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N 6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N 6	1.	10.	90.	9.	0.	0.	0.	0.	1.	10.	90.	9.
N 6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N 6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N 6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N	141.	1183.	32086.	179.	70.	610.	11543.	107.	71.	573.	13878.	118.
N	355.	3891.	783353.	885.	276.	3032.	557300.	747.	79.	860.	37160.	193.
N	433.	4271.	1337741.	1157.	340.	3567.	1159159.	1077.	93.	704.	26740.	164.
N	3.	12.	108.	10.	3.	12.	108.	10.	0.	0.	0.	0.
N	11.	54.	383.	20.	1.	3.	6.	2.	10.	51.	377.	19.
N	1011.	16296.	16199050.	4025.	648.	13684.	15805754.	3976.	363.	2613.	266247.	516.

164

Expansion Data for Florida East Coast and the Florida Keys

A S		CAUGHT				RELEASED				BOATED		
	SAMPLE	T-HAT	VARIANCE	STD ERR	SAMPLE	T-HAT	VARIANCE	STD ERR	SAMPLE	T-HAT	VARIANCE	STD ERR
F 1	18.	162.	9334.	97.	10.	90.	3737.	61.	8.	72.	1579.	40.
F 1	21.	189.	7085.	84.	7.	63.	787.	28.	14.	126.	6321.	80.
F 1	345.	3731.	1592743.	1262.	152.	1681.	137180.	370.	193.	2050.	1434380.	1198.
F 1	4.	36.	1152.	34.	0.	0.	0.	0.	4.	36.	1152.	34.
F 1	3.	27.	215.	15.	1.	9.	72.	8.	2.	18.	144.	12.
F 1	307.	8708.	11556608.	3400.	174.	2818.	534202.	731.	133.	5890.	7860851.	2804.
F 2	22.	640.	35651.	189.	16.	586.	34364.	185.	6.	54.	1295.	36.
F 2	22.	573.	33212.	182.	15.	385.	26574.	163.	7.	188.	6411.	80.
F 2	800.	21401.	31777885.	5637.	600.	16563.	28494886.	5338.	200.	4837.	1606674.	1268.
F 2	14.	126.	8347.	91.	2.	18.	288.	17.	12.	108.	5757.	76.
F 2	48.	560.	24934.	158.	10.	215.	6907.	83.	38.	345.	17826.	134.
F 2	647.	15335.	10514708.	3243.	410.	6438.	3262167.	1806.	237.	8898.	7275140.	2697.
F 3	31.	199.	1371.	37.	22.	160.	941.	31.	9.	39.	228.	15.
F 3	37.	234.	7565.	87.	20.	122.	2417.	49.	17.	112.	1776.	42.
F 3	930.	5630.	621966.	789.	774.	4478.	453994.	674.	156.	1152.	38703.	197.
F 3	7.	32.	264.	16.	6.	26.	234.	15.	1.	6.	30.	5.
F 3	42.	316.	5225.	72.	6.	52.	439.	21.	36.	264.	3233.	57.
F 3	762.	9575.	11673131.	3417.	528.	7917.	10580335.	3253.	234.	1657.	227807.	477.
F 4	37.	187.	2836.	53.	25.	114.	1558.	39.	12.	73.	519.	23.
F 4	38.	338.	9320.	97.	18.	87.	967.	31.	20.	251.	7954.	89.
F 4	1311.	14227.	17869767.	4227.	971.	11105.	14039284.	3747.	340.	3122.	464527.	682.
F 4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
F 4	18.	131.	1307.	36.	0.	0.	0.	0.	18.	131.	1307.	36.
F 4	478.	6117.	2721387.	1650.	194.	2434.	514559.	717.	284.	3684.	2170096.	1473.
F 5	2.	36.	603.	25.	1.	18.	305.	17.	1.	18.	305.	17.
F 5	3.	54.	1511.	39.	2.	36.	603.	25.	1.	18.	305.	17.
F 5	126.	2261.	1887152.	1374.	103.	1846.	1528262.	1236.	23.	414.	134906.	367.
F 5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
F 5	1.	18.	305.	17.	0.	0.	0.	0.	1.	18.	305.	17.
F 5	24.	429.	50887.	226.	10.	189.	6798.	82.	14.	240.	44451.	211.
F 6	2.	20.	360.	19.	2.	20.	360.	19.	0.	0.	0.	0.
F 6	1.	10.	90.	9.	0.	0.	0.	0.	1.	10.	90.	9.
F 6	17.	170.	6679.	82.	8.	80.	1965.	44.	9.	90.	2231.	47.
F 6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
F 6	2.	20.	179.	13.	0.	0.	0.	0.	2.	20.	179.	13.
F	112.	1244.	50155.	224.	76.	988.	41265.	203.	36.	256.	3926.	63.
F	122.	1398.	58783.	242.	62.	693.	31348.	177.	60.	705.	22857.	151.
F	3529.	47419.	53756192.	7332.	2608.	35753.	44655571.	6682.	921.	11666.	3681421.	1919.
F	25.	194.	9763.	99.	8.	44.	522.	23.	17.	150.	6939.	83.
F	112.	1052.	31986.	179.	17.	276.	7418.	86.	95.	776.	22815.	151.
F	2220.	40184.	36516900.	6043.	1316.	19796.	14898061.	3860.	904.	20388.	17578524.	4193.

Expansion Data for the Gulf of Mexico

A S	CAUGHT SAMPLE	T-HAT	VARIANCE	STD ERR	RELEASED SAMPLE	T-HAT	VARIANCE	STD ERR	BOATED SAMPLE	T-HAT	VARIANCE	STD ERR
G 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
G 1	2.	18.	288.	17.	2.	18.	288.	17.	0.	0.	0.	0.
G 1	3.	183.	8796.	94.	1.	9.	72.	8.	2.	174.	8724.	93.
G 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
G 1	4.	275.	27110.	165.	2.	257.	26828.	164.	2.	18.	288.	17.
G 1	227.	5626.	6532605.	2556.	111.	4343.	5310551.	2304.	116.	1283.	386362.	622.
G 2	31.	297.	6376.	80.	21.	204.	3779.	61.	10.	93.	1775.	42.
G 2	47.	453.	26044.	161.	13.	132.	4176.	65.	34.	321.	14165.	119.
G 2	128.	1682.	129668.	360.	46.	429.	10024.	100.	82.	1253.	113464.	337.
G 2	15.	135.	10719.	104.	0.	0.	0.	0.	15.	135.	10719.	104.
G 2	5.	242.	21396.	146.	2.	21.	204.	14.	3.	221.	21196.	146.
G 2	1854.	22732.	6868510.	2621.	1031.	13498.	4422228.	2103.	823.	9234.	1582743.	1258.
G 3	70.	516.	13583.	117.	41.	317.	8006.	89.	29.	199.	3053.	55.
G 3	101.	426.	8066.	90.	48.	223.	3895.	62.	53.	203.	2111.	46.
G 3	312.	1347.	112665.	336.	196.	809.	77600.	279.	116.	537.	15785.	126.
G 3	31.	96.	5427.	74.	1.	6.	30.	5.	30.	90.	5397.	73.
G 3	15.	185.	12500.	112.	0.	0.	0.	0.	15.	185.	12500.	112.
G 3	1447.	8965.	2354671.	1534.	861.	4275.	906413.	952.	586.	4690.	1097638.	1048.
G 4	24.	385.	30217.	174.	5.	30.	269.	16.	19.	355.	29719.	172.
G 4	116.	2690.	1346265.	1160.	76.	2092.	912374.	955.	40.	598.	45243.	213.
G 4	89.	1721.	459878.	678.	49.	1338.	345076.	587.	40.	384.	14263.	119.
G 4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
G 4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
G 4	512.	7640.	9299135.	3049.	277.	6193.	7825660.	2797.	235.	1447.	160222.	400.
G 5	2.	36.	1221.	35.	0.	0.	0.	0.	2.	36.	1221.	35.
G 5	2.	27.	372.	19.	1.	9.	67.	8.	1.	18.	305.	17.
G 5	8.	117.	4282.	65.	0.	0.	0.	0.	8.	117.	4282.	65.
G 5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
G 5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
G 5	85.	1441.	1720416.	1312.	0.	0.	0.	0.	85.	1441.	1720416.	1312.
G 6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
G 6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
G 6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
G 6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
G 6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
G 6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
G	127.	1233.	51397.	227.	67.	551.	12054.	110.	60.	683.	35768.	189.
G	268.	3615.	1381035.	1175.	140.	2474.	920800.	960.	128.	1141.	61824.	249.
G	540.	5051.	715289.	846.	292.	2585.	432772.	658.	248.	2466.	156518.	396.
G	46.	231.	16146.	127.	1.	6.	30.	5.	45.	225.	16116.	127.
G	24.	702.	61006.	247.	4.	218.	27032.	164.	20.	424.	33984.	184.
G	4125.	46405.	26775337.	5174.	2280.	28309.	18464852.	4297.	1845.	18096.	4947381.	2224.

Expansion Data for Puerto Rico and the U.S. Virgin Islands

A S	CAUGHT				RELEASED				BOATED			
	SAMPLE	T-HAT	VARIANCE	STD ERR	SAMPLE	T-HAT	VARIANCE	STD ERR	SAMPLE	T-HAT	VARIANCE	STD ERR
P 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
P 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
P 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
P 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
P 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
P 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
P 2	18.	72.	1578.	40.	14.	42.	877.	30.	4.	30.	540.	23.
P 2	2.	18.	288.	17.	2.	18.	288.	17.	0.	0.	0.	0.
P 2	13.	78.	2225.	47.	10.	60.	1949.	44.	3.	18.	156.	12.
P 2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
P 2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
P 2	4.	18.	101.	10.	1.	9.	72.	8.	3.	9.	29.	5.
P 3	25.	135.	12062.	110.	15.	79.	4334.	66.	10.	56.	1968.	44.
P 3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
P 3	5.	11.	25.	5.	4.	9.	24.	5.	1.	2.	2.	1.
P 3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
P 3	1.	3.	6.	2.	1.	3.	6.	2.	0.	0.	0.	0.
P 3	5.	10.	17.	4.	4.	8.	15.	4.	1.	2.	2.	1.
P 4	3.	6.	9.	3.	0.	0.	0.	0.	3.	6.	9.	3.
P 4	5.	10.	49.	7.	0.	0.	0.	0.	5.	10.	49.	7.
P 4	2.	4.	4.	2.	0.	0.	0.	0.	2.	4.	4.	2.
P 4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
P 4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
P 4	7.	18.	56.	7.	3.	6.	18.	4.	4.	12.	39.	6.
P 5	41.	693.	440661.	664.	35.	630.	373787.	611.	6.	63.	2797.	53.
P 5	1.	3.	6.	2.	0.	0.	0.	0.	1.	3.	6.	2.
P 5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
P 5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
P 5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
P 5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
P 6	17.	170.	6216.	79.	6.	60.	3234.	57.	11.	110.	2094.	46.
P 6	8.	80.	1178.	34.	0.	0.	0.	0.	8.	80.	1178.	34.
P 6	8.	80.	1910.	44.	2.	20.	359.	19.	6.	60.	1589.	40.
P 6	1.	10.	90.	9.	0.	0.	0.	0.	1.	10.	90.	9.
P 6	7.	70.	4402.	66.	0.	0.	0.	0.	7.	70.	4402.	66.
P 6	73.	730.	102444.	320.	40.	400.	75175.	274.	33.	330.	15003.	122.
P	104.	1077.	460526.	679.	70.	812.	382232.	618.	34.	265.	7408.	86.
P	16.	111.	1521.	39.	2.	18.	288.	17.	14.	93.	1233.	35.
P	28.	173.	4164.	65.	16.	89.	2332.	48.	12.	84.	1751.	42.
P	1.	10.	90.	9.	0.	0.	0.	0.	1.	10.	90.	9.
P	8.	73.	4408.	66.	1.	3.	6.	2.	7.	70.	4402.	66.
P	89.	776.	102618.	320.	48.	423.	75280.	274.	41.	353.	15073.	123.

Expansion Data for Other Waters

A S	CAUGHT				RELEASED				BOATED			
	SAMPLE	T-HAT	VARIANCE	STD ERR	SAMPLE	T-HAT	VARIANCE	STD ERR	SAMPLE	T-HAT	VARIANCE	STD ERR
0 1	2.	18.	288.	17.	0.	0.	0.	0.	2.	18.	288.	17.
0 1	10.	90.	4894.	70.	7.	63.	3527.	59.	3.	27.	360.	19.
0 1	4.	36.	719.	27.	4.	36.	719.	27.	0.	0.	0.	0.
0 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0 1	36.	324.	44979.	212.	35.	315.	42897.	207.	1.	9.	72.	8.
0 2	17.	183.	6067.	78.	12.	129.	5383.	73.	5.	54.	540.	23.
0 2	21.	237.	22111.	149.	17.	189.	20791.	144.	4.	48.	1320.	36.
0 2	58.	627.	69772.	264.	52.	564.	63667.	252.	6.	63.	612.	25.
0 2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0 2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0 2	20.	225.	8426.	92.	10.	108.	4005.	63.	10.	117.	3105.	56.
0 3	41.	433.	9427.	97.	21.	349.	7612.	87.	20.	84.	704.	27.
0 3	19.	161.	2794.	53.	12.	122.	1708.	41.	7.	39.	1086.	33.
0 3	36.	272.	5324.	73.	31.	255.	5234.	72.	5.	17.	54.	7.
0 3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0 3	1.	6.	30.	5.	1.	6.	30.	5.	0.	0.	0.	0.
0 3	316.	1672.	188568.	434.	268.	1406.	154900.	394.	48.	266.	5628.	75.
0 4	39.	258.	7050.	84.	18.	105.	3147.	56.	21.	153.	2008.	45.
0 4	41.	635.	84942.	291.	23.	459.	54277.	233.	18.	177.	4257.	65.
0 4	171.	744.	155938.	395.	134.	534.	59194.	243.	37.	210.	32678.	181.
0 4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0 4	2.	12.	120.	11.	0.	0.	0.	0.	2.	12.	120.	11.
0 4	40.	215.	15341.	124.	14.	76.	3190.	56.	26.	139.	12072.	110.
0 5	4.	72.	2411.	49.	4.	72.	2411.	49.	0.	0.	0.	0.
0 5	3.	54.	1511.	39.	1.	18.	305.	17.	2.	36.	603.	25.
0 5	9.	162.	10507.	103.	4.	72.	4883.	70.	5.	90.	3304.	57.
0 5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0 5	2.	36.	1221.	35.	0.	0.	0.	0.	2.	36.	1221.	35.
0 5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0 6	2.	20.	180.	13.	1.	10.	90.	9.	1.	10.	90.	9.
0 6	7.	70.	3313.	58.	0.	0.	0.	0.	7.	70.	3313.	58.
0 6	4.	40.	1432.	38.	1.	10.	90.	9.	3.	30.	806.	28.
0 6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0 6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0 6	10.	100.	8953.	95.	0.	0.	0.	0.	10.	100.	8953.	95.
0	105.	984.	25423.	159.	56.	665.	18643.	137.	49.	319.	3630.	60.
0	101.	1248.	119565.	346.	60.	851.	80608.	284.	41.	397.	10939.	105.
0	282.	1880.	243692.	494.	226.	1470.	133787.	366.	56.	410.	37454.	194.
0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0	5.	54.	1371.	37.	1.	6.	30.	5.	4.	48.	1341.	37.
0	422.	2536.	266267.	516.	327.	1905.	204992.	453.	95.	631.	29830.	173.